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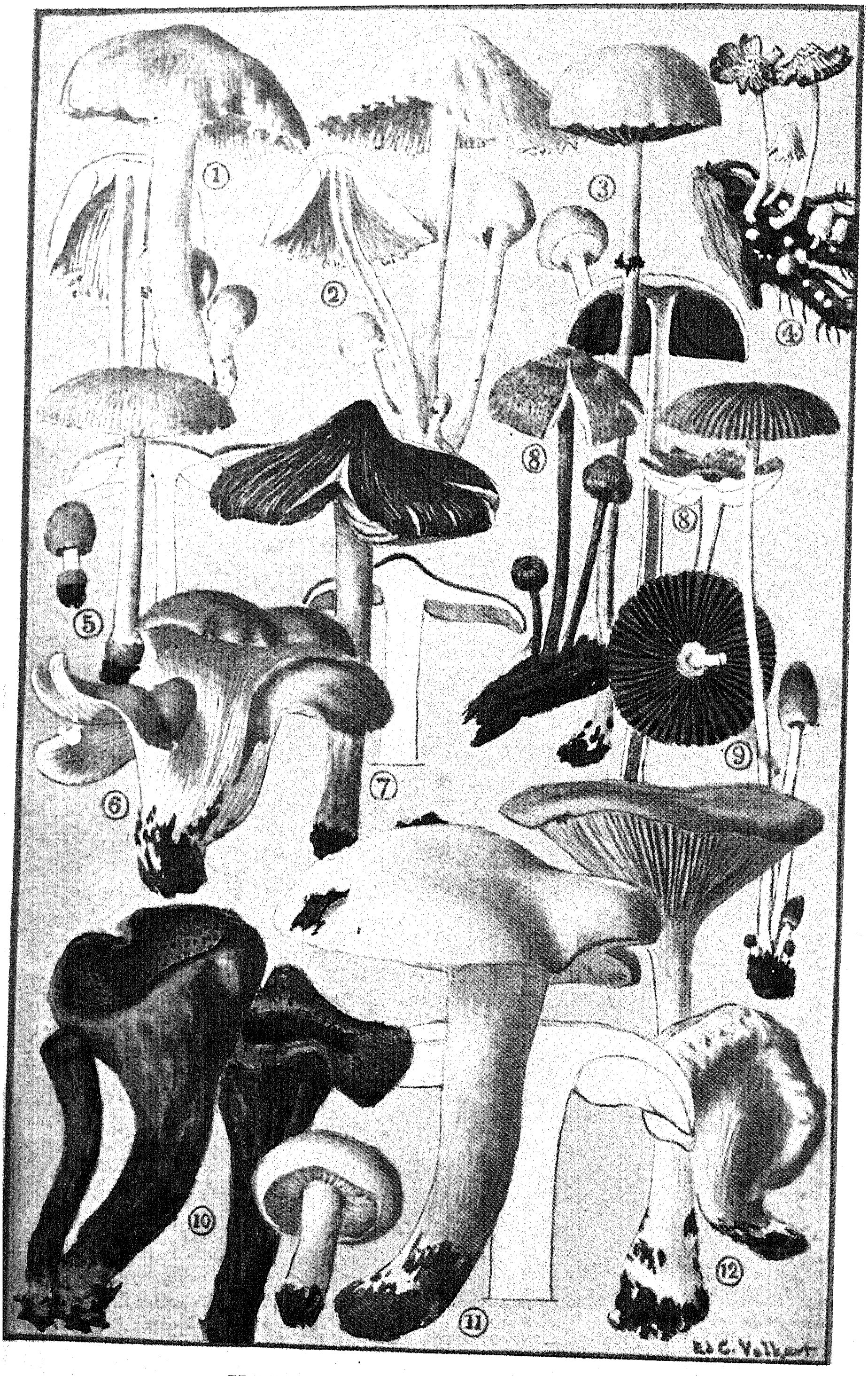

ILLUSTRATIONS OF FUNGI

MYCOLOGIA

VOL. IV JANUARY, 1912 No. 1

ILLUSTRATIONS OF FUNGI—X

WILLIAM A. MURRILL

All of the accompanying illustrations were drawn from specimens collected in the vicinity of Bronx Park. They are reproduced here natural size, but some of them, especially figures 5, 6, and 12, represent rather small forms of the species in question.

Hypholoma appendiculatum (Bull.) Quél.

APPENDICULATE HYPHOLOMA

PLATE 56. FIGURES 1 and 2. × 1

Pileus fleshy, fragile, thin, convex to expanded, cespitose or gregarious, 2–6 cm. broad; surface glabrous or whitish-pulverulent, rarely floccose-scaly, usually cracking with age, hygrophanous, varying in color from pale-yellowish to light-brown or dark honey-yellow, fading when old or dry; lamellae adnate, close, narrow, white or creamy-white to purplish-brown; spores ovoid, smooth, purplish-brown, $7 \times 4 \mu$; stipe slender, equal, hollow, white, glabrous below, pruinose at the apex, 5–7 cm. long, 4–6 mm. thick; veil white, delicate, evanescent, clinging to the margin of young plants as shred-like appendages.

This is everywhere recognized as one of the best and most dainty edible species. It is very widely distributed and grows in abundance throughout the season about dead wood or in soil rich in decayed wood. The two figures represent two color forms found growing together at the base of an elm.

[MYCOLOGIA for November, 1911 (3: 271–304), was issued November 20, 1911]

Stropharia semiglobata (Batsch) Quél.

HEMISPHERIC STROPHARIA

PLATE 56. FIGURE 3. $\times$ 1

Pileus fleshy, subglobose to hemispheric, gregarious to subcespitose, 1–3 cm. broad; surface light-yellow, smooth, glabrous, very viscid when moist; lamellae adnate, broad, yellow, soon clouded with the ripening spores; spores ellipsoid, smooth, brownish-purple, $12–14 \times 7–9\,\mu$; stipe slender, cylindric, light-yellow, smooth, viscid, 6–9 cm. long, 2–4 mm. thick; veil glutinous when moist, leaving an incomplete, superior ring.

Common and widely distributed but rarely abundant in manured fields or on dung in pastures throughout the growing season. Stevenson says it is considered poisonous, but later authors claim that it is edible, although its favorite habitat and its slimy character are objectionable to most persons. The name is exceedingly well chosen, as the shape of its cap is as near an exact hemisphere as one is able to find among living things.

Coprinus Brassicae Peck

CABBAGE COPRINUS

PLATE 56. FIGURE 4. $\times$ 1

Pileus membranous, conic or ovoid to oblong, at length expanding, the margin often recurving and splitting, closely gregarious or cespitose by crowding, about 7–10 mm. broad; surface white, squamulose, finely striate, becoming isabelline, with the scales showing in patches; lamellae adnexed, narrow, crowded, ferruginous-brown; spores broadly ellipsoid, almost subglobose, smooth, umbrinous under the microscope, $7 \times 5\,\mu$; stipe slender, snow-white, smooth, glabrous, hollow, 1–2 cm. long, less than 1 mm. thick, except at the base; veil represented by a ring of delicate, powdery scales at the base of the stipe, which are similar to those on the pileus.

This species was first described by Dr. Peck from plants he collected on decaying cabbage stems at Menands, New York, in August, 1889. Last June it occurred in abundance on a pile of cornstalks in thin woods east of Bronx Park. The identity of the species was suggested by Professor L. H. Pennington, who was working upon the genus at the Garden a little later in the year.

Vaginata farinosa (Schw.) Murrill

MEALY AGARIC

PLATE 56. FIGURE 5. × 1

Pileus thin, nearly plane, 2–3 cm. broad; surface grayish to murinous, deeply striate on the margin, floccose-powdery, especially on the disk; lamellae free, white; spores subglobose to ovoid or ellipsoid, smoth, 6–7 μ; stipe cylindric, hollow or stuffed, white or gray, subbulbous, farinaceous, 4–7 cm. long, 3–6 mm. thick; volva floccose-powdery, evanescent.

This species was described from North Carolina as an *Amanita* and later placed in *Amanitopsis*. It is more common in Virginia and farther south than it is in New York, although occurring in open deciduous woods throughout the eastern United States. The plant is too small and scattered to be considered economically.

Pleurotus geogenius (DC.) Quél.

EARTH-LOVING PLEUROTUS

PLATE 56. FIGURE 6. × 1

Pileus fleshy, erect, fan-shaped or semi-infundibuliform, often divided nearly to the base, at other times wavy or lobed at the margin, which is at first incurved, 4–9 cm. broad; surface smoth, glabrous above, whitish-pruinose behind, avellaneous-isabelline to chestnut-brown, dry or viscid according to the weather; lamellae white, narrow, crowded, sometimes forked behind, decurrent to the base of the stipe or nearly so; spores subovoid, smooth, hyaline, 7–8 × 3.5–4 μ; cystidia fusoid, hyaline, 60–70 × 12–15 μ; stipe always lateral with a dorsal groove, short, white, pruinose, 1–3 cm. long, 5–15 mm. thick; flesh white, with farinaceous odor and taste.

For the last three seasons, this species has appeared in abundance on my lawn in the shadow of the house, and I have had the opportunity to study it very closely. On first comparing it in Europe with specimens of *P. geogenius,* it seemed very different, the European form being darker, thicker, and firmer, with longer and thicker stipe. Specimens collected last October, however, were much darker than usual, and others found later near Seattle, Washington, first by Mr. S. M. Zeller and afterwards by myself on two occasions, proved to be quite typical both in color and

form. The spores and cystidia of the New York plant are slightly smaller than those of the European form. The pileus is very viscid in wet weather.

There is no reference, so far as I know, to the occurrence of this species in America. Its habitat for a *Pleurotus* is so peculiar that it would probably be referred to *Clitocybe* or some other genus. The New York specimens grew among the grass, in slight depressions between the clumps; the Washington specimens were found in bare ground out in the open; while in Europe the species often occurs in the woods.

Inocybe rimosa (Bull.) Quél.

CRACKED INOCYBE

PLATE 56. FIGURE 7. × 1

Pileus fleshy, thin, broadly conic or campanulate to expanded, obtuse or umbonate, 2.5–5 cm. broad; surface silky-fibrous, radiate-rimose, yellowish-brown; lamellae adnexed, pallid to tan or subferruginous; spores ovoid to ellipsoid, smooth, dull-ferruginous, 7–9 × 3.5–5 μ; cystidia very scarce, 60–65 × 15–18 μ; stipe equal, firm, solid, pruinose at the apex, subglobose below, pallid, slightly bulbous at the base, 2–5 cm. long, 4–6 mm. thick.

Very common throughout the northern hemisphere on the ground in woods, and usually recognizable by its very conspicuous radiate splitting. It is considered poisonous by Kobert. None of the species of the genus should be eaten, because some of them are poisonous and the distinctions are very difficult to make.

Collybidium zonatum (Peck) Murrill

ZONED COLLYBIDIUM

PLATE 56. FIGURE 8. × 1

Pileus thin, convex or nearly plane, umbilicate, much resembling a *Marasmius*, usually cespitose, 1–2.5 cm. broad; surface fibrillose-tomentose, tawny or ochraceous-tawny, sometimes marked with slightly darker zones; lamellae narrow, close, free, white or whitish, edges whitish-pulverulent; spores broadly ellipsoid, smooth, hyaline, 5–7 × 3–4 μ; stipe firm, equal, hollow, similar to the pileus in color and covering, 2.5–5 cm. long, 2 mm. thick.

Described by Peck as a *Collybia* from specimens collected at

the base of an elm in Albany, New York, and afterwards found in several other eastern states on dead roots and buried twigs in partial shade. A smaller species very similar to this has also been described by Peck as *Collybia stipitaria*. They will both probably be referred to a division of *Marasmius* when that large genus is segregated.

Coprinus Spraguei Berk. & Curt.

SPRAGUE'S COPRINUS

PLATE 56. FIGURE 9. × 1

Pileus very thin, ovoid to campanulate-conic, at length expanded, somewhat depressed, 2–2.5 cm. broad; surface plicate with striate margin, subtomentose, grayish, becoming avellaneous along the ridges and fumosous in the grooves, umbo glabrous, light-brown, avellaneous when old; lamellae free, few, narrow; spores ellipsoid, smooth, black, $8–9 \times 4–5\,\mu$; stipe white or light-brownish, smooth, glabrous, shining, hollow, surmounted by a disk at the apex to which the lamellae are attached, 5–7 cm. long, 1–2 mm. thick.

Common in the eastern United States in rich grassy or partially shaded places, either single or slightly clustered. It was first named from Sprague's collections in New England but has been known under several names in this country. Our New York plants agree well with the types at Kew.

Craterellus cornucopioides (L.) Pers.

HORN OF PLENTY. FAIRIES' LOVING CUP

PLATE 56. FIGURE 10. × 1

Pileus trumpet-shaped, thin, flexible, gregarious or cespitose, 5–10 cm. long, reaching 8 cm. broad at the top, margin erect to decurved and lobed; surface more or less scaly, blackish-brown; hymenium even or somewhat wrinkled, cinereous; spores ellipsoid, smooth, subhyaline, $12–17 \times 7–8\,\mu$; stipe very short or obsolete.

This species is exceedingly easy to recognize by its shape and color, and is considered very good for the table. It occurs during late summer and fall in open woods throughout a wide area of distribution in temperate regions.

Hygrophorus flavodiscus Frost

YELLOW-DISKED HYGROPHORUS

PLATE 56. FIGURE 11. × 1

Pileus fleshy, convex or nearly plane, 3–8 cm. broad; surface glabrous, very viscid, white with pale-yellow or reddish-yellow center; flesh white; lamellae adnate or decurrent, subdistant, white, slightly tinged with flesh-color at times, the interspaces sometimes venose; spores ellipsoid, smooth, hyaline, 6–7.5 × 4–5 μ; stipe subequal, solid, very viscid, white at the apex, white or yellowish below, 3–8 cm. long, 6–12 mm. thick.

A beautiful species, occurring in woods in autumn. Peck published it with Frost's name and notes in the 35th annual state report, the plant being represented at the time by specimens from Vermont and New York.

Pleuropus abortivus (Berk. & Curt.) Murrill

Clitopilus abortivus (Berk. & Curt.) Sacc.

ABORTIVE PLEUROPUS

PLATE 56. FIGURE 12. × 1

Pileus of developed form fleshy, firm, convex to nearly plane or slightly depressed, usually entire on the margin, gregarious or cespitose, 5–10 cm. broad, the sporophores very commonly represented by subglobose aborted masses of cellular tissue 3–6 cm. in diameter; surface of developed form dry, silky-tomentose, becoming glabrous, gray or grayish-brown; flesh white, with farinaceous odor and taste; lamellae adnate, close, thin, strongly decurrent, whitish or pale-grayish, changing to salmon-colored; spores angular, uninucleate, salmon-colored, 8.5–10 × 6–7.5 μ; stipe subequal, solid, slightly flocculose, longitudinally striate, concolorous or paler than the pileus, 3.5–8 cm. long, 5–12 mm. thick.

Common on rich earth or much decayed wood in woods during late summer and autumn, from Canada to Alabama and west to Wisconsin and Mexico. It was very abundant about New York last September. It is an excellent edible species both in its fully developed and aborted forms, the latter being gathered by the Indians for the market in some parts of Mexico.

CULTURES OF UREDINEAE IN 1910

J. C. Arthur

The present article is the eleventh of a series of reports[1] by the writer upon the culture of plant rusts, beginning in 1899. Almost uniform progress has been made during the twelve years in the prime purpose of the work, that of experimentally connecting the sporophytic and gametophytic phases of heteroecious rusts, as well as the study of autoecious species and in some cases the detection of races. The work of the year is representative in these several respects. It was under the charge of Miss Irma A. Uhde, a senior student in general science in the University of Iowa, who was recommended by Professor Thomas H. Macbride. Miss Uhde conducted the work with fine insight and untiring patience, securing a notably large number of successful infections. Some of the sowings, particularly those of the cedar rusts were made and the records kept by Dr. F. D. Kern. All the work was done under the auspices of the Indiana Experiment Station, and financed from the Adams fund.

There are some very common American rusts that collectors of culture material are likely to send in considerable abundance every year, such as *Puccinia Caricis, P. Peckii, P. angustata* and the *Aster-Solidago-Erigeron* group among the sedge rusts, and *P. poculiformis, P. pustulata, P. Andropogonis, P. Impatientis* and *P. fraxinata* among the grass rusts. These are usually sown, although the life cycle is known, and when time and opportunity permit some tests are made regarding their less known aecial hosts and the possibility of races. While these and similar species take time that could usually be put upon less known forms to better advantage, there is another set of common rusts often sent by collectors, whose life cycle is not known, such as *Puccinia emaculata, P. Ellisiana, P. vexans,* and the form on *Carex Penn-*

[1] See Bot. Gaz. **29**: 268–276; **35**: 10–23; Jour. Myc. **8**: 51–56; **10**: 8–21; **11**: 50–67; **12**: 11–27; **13**: 189–205; **14**: 7–26; Mycol. **1**: 225–256; and **2**: 213–240.

sylvanica, which consume time with no more profit. They have been repeatedly sown, but for want of careful field observations regarding proximity of aecia, little advance is made.

Those who assisted in the work with culture material, and often with valuable suggestions, are named with special gratitude, for to them is due in considerable degree whatever of value has come from the year's labors. Mr. E. Bethel, Denver, Colo., sent 123 collections, by far the largest number contributed by one person in any year since the work began. Messrs. W. P. Fraser, Pictou, Nova Scotia, J. F. Brenckle, Kulm, N. D., and W. H. Long, Washington, D. C., sent between 30 and 40 collections each, while much smaller numbers were sent by Messrs. E. Bartholomew, Stockton, Kans., J. M. Bates, Red Cloud, Neb., H. S. Coe, Ames, Iowa, J. J. Davis, Racine, Wis., A. C. Dillman, Washington, D. C., H. S. Fawcett, Gainesville, Fla., A. O. Garrett, Salt Lake City, Utah, R. A. Harper, Madison, Wis., E. W. D. Holway, Minneapolis, Minn., Haven Metcalf, Washington, D. C., A. J. Norman, College Park, Md., E. W. Olive, Brookings, S. D., J. B. Pollock, Ann Arbor, Mich., Donald Reddick, R. E. Stone, and H. H. Whetzel, all three of Ithaca, N. Y., Guy West Wilson, Fayette, Iowa, and by Misses Louise Falk, Boulder, Colo., and Miriam Turner, Isle au Haut, Me. Many living plants were received from a number of botanists to whom requests had been sent for suitable specimens on which to make sowings of particular rusts. To all these and to others who assisted in the year's investigations the writer extends his heartiest thanks.

During the present season 294 collections of material with resting spores and 25 collections with active spores were employed, from which 987 drop cultures were made to test the germinating condition of the spores. Out of the 294 collections with resting spores 134 failed to germinate, leaving 160 collections available for experimental tests, this being a far larger number than in any previous year. Altogether about 400 sowings were made, using a great variety of hosts growing in pots in the greenhouse, and 75 infections obtained. The most important conclusions derived from a study of the results are given in the following paragraphs.

NEGATIVE RESULTS.—A number of collections giving good ger-

mination of the spores were sown on plants in the hope of discovering the alternate host but without securing infection. The following are recorded to serve for reference in future studies.

1. PUCCINIA on *Carex Pennsylvanica* L., collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown on *Laciniaria punctata* (on 4 different dates), *L. spicata, Dirca palustris* (2 dates), and *Meriolix serrulata* (2 dates), with no infection. In preceding years this rust was sown on forty other species of hosts without infection.[2]

2. PUCCINIA on *Carex tenella* Schk., collected at Pictou, Nova Scotia, by Professor W. P. Fraser, was sown on *Phryma leptostachya* (on 2 different dates), with no infection. In 1909 a similar collection was sown on six other species of hosts with no results.[3]

3. PUCCINIA on *Carex stellulata* Good., collected by the writer at Isle au Haut, Me., was sown on *Aster Drummondii, Solidago canadensis,* and *Ribes Cynosbati,* with no infection.

4. PUCCINIA on *Carex trisperma* Dewey, collected at Pictou, Nova Scotia, by Professor W. P. Fraser, was sown on *Myrica cerifera, Apocynum cannabinum, Senecio Douglasii,* and *Solidago caesia,* with no infection.

5. PUCCINIA on *Carex arctata* Boott, collected at Pictou, Nova Scotia, by Professor W. P. Fraser, was sown on *Lysimachia terrestris, L. quadrifolia, Chelone glabra* (on 2 different dates), *Rudbeckia laciniata,* and *R. triloba,* with no infection.

6. PUCCINIA PERMINUTA Arth., on *Agrostis hyemalis* (Walt.) B. S. P., collected by the writer at Isle au Haut, Me., was sown on *Orchis spectabilis* and *Actaea alba,* with no infection. Another collection on *A. perennans* (Walt.) Tuckerm., collected at Pictou, Nova Scotia, by Professor W. P. Fraser, was sown on *Aquilegia canadensis, Thalictrum dioicum, Caulophyllum thalictroides, Anemonella thalictroides,* and *Isopyrum biternatum,* with no infection.

7. PUCCINIA ELLISIANA Thüm., on *Andropogon scoparius* Michx., collected by Dr. J. F. Brenckle, at Kulm, N. D., was

[2] See Jour. Myc. 10: 10. 1904; 11: 51. 1905; 12: 12. 1906; 13: 191. 1907; 14: 9. 1908; and Mycol. 1: 229. 1909.

[3] See Mycol. 1: 218. 1910.

sown on *Boehmeria cylindrica, Uvularia grandiflora, Myrica cerifera, Lysimachia quadrifolia, Thalictrum polygamum,* and *Laciniaria spicata,* with no infection. Similar material from Colorado, Nebraska, Delaware and North Carolina was sown in previous seasons on thirty five other species of hosts.[4]

8. PUCCINIA SCHEDONNARDI K. & S., on *Schedonnardus paniculatus* (Nutt.) Trel., collected by Mr. E. Bethel, at Westminster, Colo., was sown on *Delphinium formosum, Xanthoxylum americanum, Symphoricarpos pauciflorus, Hydrophyllum virginicum, H. capitatum, Onosmodium occidentale, Petalostemon purpureus, Amorpha nana, Boltonia asteroides, Grindelia squarrosa, Rudbeckia triloba, Laciniaria punctata, Solidago rigida,* and *Arnica* sp., with no infection. This collection possessed clean and well developed sori, and gave strong germination. Similar material in former years was sown on fifteen other species of hosts.[5]

9. PUCCINIA VIRGATA Ellis & Ev., on *Chrysopogon avenaceus* (Michx.) Benth., collected by Mr. W. H. Long at El Reno, Okla., was sown on *Dirca palustris, Xanthoxylum americanum, Boehmeria cylindrica, Apios Apios, Petalostemon purpureus,* and *Mimulus ringens,* with no infection. Similar material from Nebraska and North Carolina was sown in previous years on nine other species of hosts.[6]

10. PUCCINIA TOSTA Arth., on *Sporobolus asperifolius* Nees & Meyen, collected by Dr. J. F. Brenckle at Kulm, N. D., was sown on *Lepargyraea canadensis, Dirca palustris, Symphoricarpos racemosus, Apocynum cannabinum, Delphinium formosum, Polemonium reptans, Laciniaria punctata, Aster paniculatus,* and *Arnica* sp., with no infection.

Another collection on same host, made by Mr. E. Bethel at Denver, Colo., was sown on *Symphoricarpos racemosus, Lepargyraea canadensis, Phacelia heterophylla, Hydrophyllum virginicum, Lithospermum canescens, Amorpha fruticosa, Arabis Holboellii,* and *Sidalcea oregana,* with no infection. Similar material was sown in previous years on ten other species of hosts.[7]

[4] See Jour. Myc. 14: 10. 1908; Mycol. 1: 231. 1909; 2: 220. 1910.

[5] See Bot. Gaz. 35: 11. 1903; Jour. Myc. 13: 192. 1907; 14: 11. 1908; and Mycol. 1: 231. 1909.

[6] See Jour. Myc. 14: 10. 1908; and Mycol. 2: 219. 1910.

[7] See Jour. Myc. 10: 10. 1904; and 12: 12. 1906.

11. PUCCINIA on *Phalaris arundinacea* L., collected by Dr. E. W. Olive, at Brookings, S. D., was sown on *Polygonatum commutatum, Vagnera stellata, Convallaria majalis, Uvularia grandiflora,* and *Trillium cernuum,* with no infection.

12. PUCCINIA DISTICHLIDIS E. & E., on *Spartina* sp., collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown on *Lithospermum canescens* (on 2 different dates), *Onosmodium hispidissimum, Lepargyraea canadensis* (2 dates), *Elaeagnus angustifolia, Dirca palustris, Fraxinus lanceolata, Symphoricarpos racemosus, Aesculus glabra, Apocynum cannabinum, Hydrophyllum capitatum, Macrocalyx Nyctelea, Isopyrum biternatum, Amorpha nana, Cassia chamaecrista, Petalostemon purpureus, Physalis* sp., *Ambrosia trifida,* and *Carduus Flodmanii,* with no infection. A year ago the same rust was sown on three other hosts without results.[8]

13. PUCCINIA ANTHOXANTHI Fckl., on *Anthoxanthum odoratum* L., collected by Professor W. P. Fraser, at Pictou, Nova Scotia, was sown on *Berberis vulgaris, Myrica cerifera, Apocynum cannabinum, Tissa canadensis, Senecio lugens,* and *Rudbeckia triloba,* with no infection.

14. PUCCINIA on *Trisetum majus* (Vasey) Rydb. having covered telia and coronate teliospores, simulating *P. Rhamni,* collected in the foothills of Colorado, by Mr. E. Bethel, was sown on *Rhamnus alnifolia* from one collection, and on *Rhamnus cathartica* from another. A similar collection from Golden, Colo., with same data, was sown on the two sets of *Rhamnus,* while another collection from Boulder, Colo., was sown on *Mahonia Aquifolium* and *Arabis Holboellii.* In each instance there was no infection.

15. PUCCINIA MONTANENSIS Ellis, on *Elymus canadensis* L. collected by Mr. E. Bethel, at Colorado Springs, Colo., was sown on *Clematis virginiana* (on 2 different dates), *Viorna Douglasii* (2 dates), *Impatiens aurea, Delphinium scaposum, Viola septentrionalis, Arabis Holboellii, Amorpha nana, Senecio Douglasii,* and *Arnica* sp., with no infection. In 1907 what is thought to be the same rust was sown four times on *Delphinium tricorne* without result.[9]

[8] See Mycol. 2: 219. 1910.
[9] See Jour. Myc. 14: 11. 1908.

16. UROMYCES ELEOCHARIDIS Arth., on *Eleocharis palustris* (L.) R. & S., collected by Dr. E. W. Olive, at Brookings, S. D., was sown on *Laciniaria spicata, L. scariosa, Eupatorium serotinum, Polygala Senega, Hydrophyllum virginicum, Amorpha fruticosa, Symphoricarpos racemosus, Lepargyraea canadensis,* and *Dirca palustris,* with no infection. In 1906 the same rust was sown on five other species of hosts without results.[10]

17. UROMYCES SPARTINAE Farl., on *Spartina Michauxiana* A. S. Hitch. (usually listed as *S. cynosuroides*), collected by Professor W. P. Fraser, at Pictou, Nova Scotia, was sown on *Steironema ciliatum* (on 2 different dates), *Polemonium reptans, Phlox divaricata,* and *Tissa canadensis,* with no infection.

Another collection from the same collector and place, but on *S. patens* (Ait.) Muhl., was sown on *Steironema ciliatum* (2 dates), *Polemonium reptans,* and *Lysimachia terrestris,* with no infection.

It is evident from the present repeated inability to infect *Steironema* with *Spartina* rust from the salt marshes of the sea coast, supposedly the same species as in the interior,[11] that the status of this rust, or group of rusts, is not yet fully known. Either we are dealing with more species than heretofore recognized, or there are biological races yet undetermined.

18. UROMYCES PECKIANUS Farl., on *Distichlis spicata* (L.) Greene, collected by Professor W. P. Fraser, at Pictou, Nova Scotia, was sown on *Tissa canadensis* (on 2 different dates), *Mimulus ringens,* and *Rudbeckia laciniata,* with no infection.

19. UROMYCES GRAMINICOLA Burr., on *Panicum virgatum* L., collected by Mr. W. H. Long, at El Reno, Okla., was sown on *Dirca palustris, Apios tuberosa,* and *Boltonia asteroides,* with no infection. Another collection on the same host sent by Mr. E. Bartholomew from Stockton, Kans., was sown on *Apios tuberosa, Petalostemon purpureus, Cassia chamaecrista, Aesculus glabra, Apocynum cannabinum,* and *Laciniaria spicata,* with no infection. The same rust has been sown on eleven other species of hosts in previous years.[12]

[10] See Jour. Myc. 13: 193. 1907.

[11] For a statement regarding *Uromyces* on *Spartina* see Mycol. 2: 221. 1910.

[12] See Jour. Myc. 12: 13. 1906; Mycol. 1: 232. 1909; 2: 220. 1910.

20. UROMYCES SPOROBOLI E. & E., on *Sporobolus neglectus* Nash, collected by Dr. E. W. Olive, at Brookings, S. D., was sown on *Lepargyraea canadensis, Elaeagnus angustifolia, Amorpha nana, Erigeron annuus* (on two different dates), and *Arnica* sp., with no infection.[13]

21. AECIDIUM on *Euphorbia commutata* Engelm. was obtained in the vicinity of Lafayette, Ind., by Messrs. F. D. Kern and T. Billings. The living plants were placed in pots and continued to flourish. They bore aecia in all stages of maturity. These plants were adjusted in a moist chamber over the following hosts, so that aeciospores fell spontaneously upon the young leaves: *Astragalus canadensis, Pisum sativum, Lathyrus palustris, Medicago sativa,* and *Trifolium pratense.* No infection was obtained.

SUCCESSFUL CULTURES SUPPLEMENTING PREVIOUS WORK.—The facts derived by growing the following species of rusts supplement those obtained from previous cultures in this series or from cultures recorded by other American or European investigators.

1. PUCCINIA GROSSULARIAE (Schum.) Lagerh., on *Carex tenuis* Rudge, collected at Pictou, Nova Scotia, by Professor W. P. Fraser, was sown April 7 on *Erigeron annuus, Solidago canadensis, Aster paniculatus* and *Ribes Cynosbati,* with infection only on the last,[14] showing pycnia April 16, and aecia April 25. Similar material obtained by the writer at Isle au Haute, Me., was sown on the same hosts, but omitting *Erigeron,* and with similar results.

A collection on *Carex pallescens* L., made by Professor W. P. Fraser at Pictou, Nova Scotia, the previous fall, was sown April 8 on *Erigeron annuus, Solidago canadensis, Aster paniculatus* and *Ribes Cynosbati,* with infection only on the last, showing abundant pycnia April 16, and aecia April 22. A similar collection, made by Prof. Fraser in the spring, was sown April 18, without infection, on *Lysimachia terrestris, Lactuca scariola, Rudbeckia laciniata, Polygala Senega* and *Apocynum cannabinum.* Two days earlier it was sown on *Ribes Cynosbati,* resulting in good infection, showing pycnia April 27, and aecia May 3.

[13] See Bot. Gaz. 35: 11. 1903.

[14] For similar negative results see Mycol. 2: 218. 1910.

The *Carex* rusts having aecia on *Ribes* are yet imperfectly known. My own culture work began in 1901, and owing to the remarkably pale aecia produced, the form in hand at the time was named *Puccinia albiperidia*. Since then many cultures have been made, and the status of the species has received considerable attention, but not until recently has any well marked morphological characters been discovered. Present studies indicate that *P. albiperidia* is a species worthy of being maintained. Beside the more or less pale aecia it possesses one basal pore in the urediniospore.

It is curious to note that the only other species of monocotyledonous rust known with a single basal pore in the urediniospore, *Uromyces uniporulus* Kern, is also on *Carex*. When published it had only been found in Connecticut on *C. tenuis*. Since then it has been detected in Wisconsin on *C. gracillima*. These are also the hosts of *P. albiperidia*, together with *C. pallescens* and *C. pubescens*. Comparing the spores, it appears that the urediniospores of the *Puccinia* and of the *Uromyces* not only agree in the pore characters, but also as to form, size and color, *i. e.*, in all morphological characters. The teliospores are also alike except in number of cells, and in the consequent length. If the sori of the *Puccinia* often contained many one-celled teliospores, and the sori of the *Uromyces* often had a few two-celled spores, *U. uniporulus* might be considered a mere mesoporic form of *P. albiperidia*. But such does not appear to be the case. However, while in the present state of uredinological taxonomy the two forms are to be maintained as distinct species belonging to different genera, yet *U. uniporulus* is doubtless only a morphological race of *P. albiperidia*. Cultures of *P. albiperidia* were made in 1901, 1903 and 1904.[15] No cultures have yet been made of *U. uniporulus*, but it probably has aecia on *Ribes*.

The far more common and widely distributed species, for which I am making the name *Puccinia Grossulariae* serve, has more deeply colored aecia and three equatorial pores in the urediniospore. I am inclined to think that this is the common gooseberry-*Carex* rust of this country and Europe, but I am not able at present to define its limits, neither can I say whether the

[15] See Jour. Myc. 8: 53. 1902; 10: 11. 1904; and in part 11: 58. 1905.

currant-*Carex* rusts belong here or not. My previous cultures[16] of this form have been reported under the name *P. albiperidia*, and confused with that species.

2. PUCCINIA PECKII (DeT.) Kellerm., on *Carex lanuginosa* Michx., collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown April 7 on *Onagra biennis* and *Meriolix serrulata*, with no infection on the latter, but with abundant pycnia on the former April 16, and aecia April 25.

Another collection on *Carex trichocarpa* Muhl., made at Carmel, Ind., by Messrs. F. D. Kern and A. G. Johnson, was sown April 13 on plants of the same two species of hosts with similar results. There was no infection of the *Meriolix*, but abundance of pycnia showed on the *Onagra* April 23, and aecia May 5. A duplicate sowing was made May 11, which gave a few pycnia on the *Meriolix*, but no aecia developed, while on the *Onagra* abundance of pycnia appeared May 19, and aecia May 27.[17]

In previous years this species of rust has been grown on *Onagra biennis* and *Gaura biennis*, the two hosts being very similar in vegetative structure. Aecia have been gathered in the field on a number of related hosts with less similarity in vegetative structure, such as *Meriolix*, but heretofore no cultural studies have been made. The present attempt may be interpreted as indicating that certain outlying hosts are infected only under exceptionally favorable circumstances, or that there exist more or less well marked races.

3. PUCCINIA CARICIS-SOLIDAGINIS Arth., on *Carex scoparia* Schk., collected by the writer at Isle au Haut, Me., was sown April 20, on *Euthamia graminifolia* (*Solidago lanceolata*) and *Solidago rugosa*, with infection only on the former, abundance of pycnia showing April 30, and aecia May 9. Another sowing was made June 10 on the same two hosts, and on *S. canadensis*, *S. nemoralis*, *Doellingeria umbellata* and *Aster paniculatus*, with

[16] See Jour. Myc. 11: 58. 1905 (in part); 12: 14. 1906; 13: 196. 1907; and 14: 13. 1908.

[17] For previous cultures see Bot. Gaz. 35: 13. 1903; Jour. Myc. 8: 52. 1902; 11: 58. 1905; 12: 15. 1906; 13: 195. 1907; Mycol. 1: 233. 1909; and 2: 222. 1910.

infection only on the *Euthamia,* showing pycnia June 18, and aecia July 5.[18]

All the hosts used in the trial are common in the vicinity where the telial material was obtained and bear aecia. It is highly probable that the aecial forms occurring on *Solidago, Aster, Erigeron, Euthamia,* and possibly *Doellingeria,* belong to one species made up of fairly well defined races. The form on *Euthamia* appears from present data to constitute a race distinct from that on *Solidago,* but is here included under the same name.

4. PUCCINIA CARICIS-ASTERIS Arth., on *Carex festiva* Dewey collected by Mr. E. Bethel, at Tolland, Colo., 9,000 feet altitude, was sown April 13, on *Aster adscendens* Lindl. (*A. Tweedyi* Rydb.), and the day following on *Onagra biennis,* with no infection on the latter and abundant infection on the former, giving pycnia April 27, and aecia May 2. Another collection with same data was sown on *Aster adscendens* April 9, and again on May 4, only the latter being effective, giving pycnia in abundance May 14, and aecia May 21.[19]

5. PUCCINIA OPIZII Bubák, on *Carex siccata* Dewey, collected by Dr. J. F. Brenckle, at Kulm, N. D., was sown as follows:

April 9, *Lactuca canadensis:* pycnia April 16, aecia April 25.
April 9, *Lactuca sativa:* pycnia April 25, aecia May 2.
April 19, *Lactuca canadensis:* pycnia April 30, aecia none.
April 19, *Lactuca sativa:* pycnia May 6, aecia none.

In the sowings on both dates the infection developed more slowly and less abundantly on the garden lettuce (*L. sativa*), than on the wild form. In both of the late sowings the aecia failed to appear, because the leaves matured too soon and died.[20]

6. PUCCINIA UNIVERSALIS Arth., on *Carex stenophylla* Wahl., collected by Mr. E. Bethel, at Boulder, Colo., was sown April 19, on *Artemisia dracunculoides,* giving abundance of pycnia April 29, and aecia May 3.[21]

[18] For previous cultures see Bot. Gaz. **35**: 21. 1903; Jour. Myc. **12**: 15. 1906; and Mycol. **1**: 233. 1909.

[19] For previous cultures see Bot. Gaz. **35**: 15. 1903; Jour. Myc. **8**: 54. 1902; **14**: 13. 1908; and Mycol. **2**: 224. 1910.

[20] For previous culture from an undetermined *Carex* see Jour. Myc. **13**: 194. 1907.

[21] For previous cultures see Jour. Myc. **14**: 21. 1908; and Mycol. **2**: 224. 1910.

7. PUCCINIA CARICIS (Schum.) Schröt., on *Carex aristata* R. Br., collected by Dr. J. F. Brenckle, at Kulm, N. D., was sown April 7, on *Urtica gracilis* and *Boehmeria cylindrica*, with infection only on the former, giving pycnia April 13, and aecia April 19.

Another collection on *Carex stricta* Lam., made in the vicinity of Lafayette, Ind., by Mr. A. G. Johnson, was sown April 13, on the same two hosts, producing infection only on *Urtica gracilis*, giving pycnia April 22, and aecia April 27. Similar results were obtained in previous years.[22]

8. PUCCINIA ANGUSTATA Peck, on *Scirpus atrovirens* Muhl., collected by Messrs. F. D. Kern and A. G. Johnson, at Carmel, Ind., was sown April 7, on *Lycopus americanus*, giving pycnia April 16, and aecia April 22. Another similar collection made by Mr. A. G. Johnson near Lafayette, Ind., was sown on same host April 13, giving pycnia April 25, and aecia May 1.[23]

9. PUCCINIA ANDROPOGONIS Schw., on *Andropogon virginicus* L., collected at Clarendon, W. Va., by Mr. W. H. Long, was sown May 13, on *Pentstemon hirsutus*, giving pycnia May 23, and aecia June 7. Another collection on *A. scoparius* Michx., made at Boulder, Colo., by Mr. E. Bethel, was sown May 12 on *Comandra umbellata* and *Pentstemon alpinus*, with infection only on the latter, and not abundant, pycnia and aecia not being observed until May 31.[24]

10. PUCCINIA PUSTULATA (Curt.) Arth., on *Andropogon furcatus* Muhl., collected at Plainview, Colo., by Mr. E. Bethel, was sown April 13, on *Comandra umbellata* and *Pentstemon barbatus*, giving rise to infection only on the former, showing pycnia April 27, and aecia May 9. Another collection by Mr. Bethel from Colorado on *Andropogon* sp., was sown May 12 on *Comandra umbellata* and *Pentstemon alpinus*, with infection only on the former, giving pycnia in abundance May 20, and aecia May 31.[25]

[22] For previous cultures see Bot. Gaz. **29**: 270. 1900; **35**: 16. 1903; Jour. Myc. **8**: 52. 1902; **12**: 15. 1906; **14**: 14. 1908; and Mycol. **2**: 223. 1910.

[23] For previous cultures see Bot. Gaz. **29**: 273. 1900; Jour. Myc. **8**: 53. 1902; **11**: 58. 1905; **13**: 196. 1907; **14**: 14. 1908; and Mycol. **1**: 234. 1909.

[24] For previous cultures see Bot. Gaz. **29**: 272. 1900; Jour. Myc. **10**: 11. 1904; and **13**: 197. 1907.

[25] For previous cultures see Jour. Myc. **10**: 17. 1904; and **12**: 16. 1906.

11. PUCCINIA AMPHIGENA Diet., on *Calamovilfa longifolia* (Hook.) Hack., collected by Dr. J. F. Brenckle, at Kulm, N. D., was sown April 25, on *Smilax hispida*, giving rise to pycnia in abundance May 2, and aecia May 14.[26]

12. PUCCINIA MUHLENBERGIAE Arth. & Holw., on *Muhlenbergia racemosa* (Michx.) B. S. P., collected by Dr. J. F. Brenckle, at Kulm, N. D., was sown May 6, on *Hibiscus militaris*, *Napaea dioica* and *Callirrhoe involucrata*, with infection only on the last, giving abundance of pycnia that were first seen May 23, and aecia May 27.[27] Another collection of the rust on *M. gracilis*, sent by Mr. E. Bethel, from the foothills of Colorado, was sown on the same three hosts, with no infection. Still a third collection, on *M. racemosa*, sent by Mr. E. Bartholomew from Stockton, Kans., was sown May 11, on *Hibiscus militaris* and *Althaea rosea*, without infection.

13. PUCCINIA RHAMNI (Pers.) Wettst., on *Calamagrostis canadensis* (Michx.) Beauv., collected by Professor W. P. Fraser, at Pictou, Nova Scotia, was sown May 26, on *Rhamnus alnifolia*, giving a strong infection, pycnia showing June 6, and aecia June 10. The only previous cultures in the series were made with aeciospores.[28]

14. PUCCINIA POCULIFORMIS (Jacq.) Wettst., on *Agropyron tenerum* Vasey, collected by Mr. E. Bethel, at Boulder, Colo., was sown April 25, on *Berberis vulgaris*, giving pycnia May 2, and aecia May 14. Another collection by Mr. Bethel, on *Sitanion longifolium* J. G. Sm., made at Eldorado Springs, Colo., was sown May 3, on *Berberis vulgaris*, giving pycnia May 14, and aecia May 26. Still another collection on *Agrostis alba* L., made by the writer at Isle au Haut, Me., was sown April 19, on *Berberis vulgaris*, giving pycnia April 29, and aecia May 9.[29]

15. PUCCINIA SUBNITENS Diet., on *Distichlis spicata* (L.) Greene, collected by Dr. J. F. Brenckle, at Kulm, N. D., was sown May 4, on *Chenopodium album*, *Monolepis Nuttalliana*, and *Cory-*

[26] For previous cultures see Bot. Gaz. 35: 20. 1903; Jour. Myc. 10: 11. 1904; 12: 16. 1906; 14: 15. 1908; and Mycol. 2: 225. 1910.

[27] For previous cultures see Mycol. 1: 251. 1909; and 2: 226. 1910.

[28] See Jour. Myc. 11: 58. 1905.

[29] For previous cultures see Jour. Myc. 8: 53. 1902; 11: 57. 1905; 12: 17. 1906; 13: 198. 1907; 14: 16. 1908; and Mycol. 2: 227. 1910.

dalis aurea, with infection only on the first, giving numerous pycnia May 16, and aecia May 21. Another sowing was made May 25, on *Chenopodium album, Monolepis Nuttalliana, Corydalis sempervirens,* and *Tissa canadensis,* and again infection was only obtained on the first, giving pycnia June 5, and aecia June 16. These attempts add nothing materially to previous knowledge.[30]

16. PUCCINIA JAMESIANA (Peck) Arth., on *Atheropogon curtipendulus* (Michx.) Fourn., collected by Mr. W. H. Long, at Amarillo, Texas, was sown April 19, on *Asclepias syriaca,* giving pycnia May 3, and aecia May 9. Previous cultures were also made with Texan material sent by Mr. Long.[31]

17. PUCCINIA SEYMOURIANA Arth., on *Spartina Michauxiana A. S. Hitch,* collected by Mr. W. H. Long, at El Reno, Okla., was sown June 3, on *Cephalanthus occidentalis,* giving numerous pycnia June 11, and aecia June 24.[32]

18. PUCCINIA STIPAE Arth., on *Stipa spartea* Trin., collected by Dr. E. W. Olive, at Brookings, S. D., was sown May 10, on *Aster ericoides* and *A. Novae-Angliae,* giving pycnia in both cases May 19, without developing aecia on *A. ericoides,* but giving aecia on *A. Novae-Angliae* May 26.

Another collection made by the writer on the same host, at Spirit Lake, Iowa, was sown April 28, on *Aster multiflorus,* giving pycnia May 6, and aecia May 17. A second sowing was made May 6, on *Aster Novae-Angliae,* with pycnia May 16, and aecia May 23; on *A. multiflorus,* with pycnia May 17, and aecia May 23; on *Solidago canadensis,* with pycnia May 24, and aecia June 6; and on *Grindelia squarrosa,* without infection.

Another collection made by Mr. E. Bethel, at Golden, Colo., on *Stipa* sp., was sown April 22, on *Aster Novae-Angliae,* with pycnia May 2, and aecia May 16, on *Grindelia squarrosa,* with pycnia May 2, and aecia May 16, and on the following hosts without infection: *Aster ericoides, A. multiflorus, Solidago cana-*

[30] For previous cultures see Bot. Gaz. **35**: 19. 1903; Jour. Myc. **11**: 54. 1905; **12**: 16. 1906; **13**: 197. 1907; **14**: 15. 1908; Mycol. **1**: 234. 1909; and **2**: 225. 1910.

[31] For previous cultures see Bot. Gaz. **35**: 18. 1903.

[32] For previous cultures see Jour. Myc. **12**: 24. 1906; and Mycol. **1**: 236. 1909.

densis, Arnica sp., *Boltonia asteroides, Laciniaria scariosa, Symphoricarpos racemosus,* and *Hydrophyllum virginicum.*

Still another collection of what appears to be the same species of rust was collected on *Koeleria cristata* (L.) Pers., by Miss Louise M. Falk, at Boulder Colo., and sown April 27, on *Senecio lugens, Grindelia squarrosa, Symphoricarpos racemosus, Hydrophyllum virginicum,* and *Arabis Holboellii,* with infection only on the first, which showed pycnia May 14, and aecia May 19.

The aecia on the several hosts, thus produced, correspond in structure, and are peculiar in having evanescent peridia, the spores being retained by the surrounding tissues of the hypertrophied leaf. The striking appearance of the aecial groups suggested one of the early synonyms: *Aecidium sclerothecioides* Ellis & Ev. These cultures, although still lacking in completeness, have enabled us to bring together a number of uncertain forms with a considerable degree of assurance, and to extend both aecial and telial hosts.

19. PUCCINIA ARGENTATA (Schultz) Wint. At my request Professor Guy West Wilson, of Fayette, Iowa, made a somewhat trying excursion to Decorah, Iowa, and with the aid of directions supplied by Professor E. W. D. Holway, who resided there for many years, obtained living plants of *Adoxa Moschatellina* L., bearing aecia, which were potted and thrived. Two sowings were made April 18, by suspending the plants of *Adoxa* bearing aecia over plants of *Impatiens aurea.* In both instances a great abundance of urediniospores began to appear May 2. Again on April 21, two more similar sowings were made on other plants of *Impatiens,* and an equal abundance of urediniospores appeared May 3. These were followed on all four plants by an unusual abundance of teliospores, the record being made June 6, although they first appeared somewhat earlier.

The aecia on *Adoxa,* which are of limited distribution in America, early attracted the writer's attention, and as early as 1883[33] a first attempt was made toward solving their life history. Since the cultures of Bubák[34] proved that the European form on *Adoxa* was the aecial stage of telia on *Impatiens,* I have attempted to

[33] Bot. Gaz. 10: 369. 1885.
[34] Centr. Bakt. 10²: 574. 1903.

secure American material for cultures, and the ample success when finally obtained is most gratifying. The American and European collections of this interesting heteroecious rust appear alike, and the present cultures show them to be identical.

20. PUCCINIA ABSINTHII DC., on a densely canescent species of *Artemisia*, collected by Mr. E. Bethel, at Boulder, Colo., was sown April 20, on *A. dracunculoides*, giving pycnia May 2, and uredinia May 20, thus confirming the previous cultures of two years ago.[35]

21. UROMYCES PERIGYNIUS Halst., on *Carex intumescens* Rudge, collected by Professor W. P. Fraser, at Pictou, Nova Scotia, was sown April 21, on *Solidago nemoralis*, again April 26, on *S. canadensis*, on May 13, on both *S. nemoralis* and *S. canadensis*, and also on *Aster paniculatus*, and finally May 14, on *Tissa canadensis* and *Artemisia ludoviciana*. Quite unexpectedly the only sowing producing infection was on *Aster*, giving pycnia May 19, and aecia May 31, both abundantly developed.

Another collection apparently of the same rust, sent by Professor Fraser, on *Carex deflexa* Hornem., was sown May 28, on *Solidago rugosa*, *S. canadensis* and *Aster Drummondii*, with infection only on the first, giving abundance of pycnia June 4, and aecia June 16.

A collection on *Carex deflexa*, collected by the writer at Isle au Haut, Me., was sown May 13, on *Solidago rugosa*, *S. nemoralis*, and *Aster ericoides*. On *S. rugosa* numerous pycnia appeared May 20, and aecia May 31, but *S. nemoralis* remained free. The *Aster*, moreover, showed pycnia May 24, and aecia June 6, but they were not numerous and grew slowly. *Solidago rugosa* has been taken with aecia in the telial vicinity, but *Aster ericoides* does not grow there neither does any closely related species of *Aster*.

Considerable study has been given to the species of *Uromyces* on *Carex* since the initial and only culture[36] in 1903. Some of the conclusions may be briefly stated, without giving the steps by which they were reached. We are doubtless dealing with races, more or less well defined, parallel with the races of the *Puccinia*-group, which latter goes under several names, two being given

[35] See Mycol. 1: 243. 1909.

[36] See Jour. Myc. 10: 15. 1904.

above under nos. 3 and 4, and which have aecia on *Aster, Solidago, Euthamia, Erigeron,* and close relatives. As the aecia and uredinia of the two groups, one under the genus *Puccinia* and the other under *Uromyces,* are indistinguishable, and as the teliospores of the *Uromyces* agree with the one-celled spores of the *Puccinia,* and also with the two-celled spores in all characters except number of cells and consequent length, the former doubtless are morphological races of the latter. Relationship could be shown better by putting all of these forms under one specific name, and designating the several races by varietal names. But in the present state of taxonomy of the rusts it is more convenient to dispose of them under the two genera: *Puccinia* and *Uromyces.*

The collection on *Carex intumescens* used in the culture is in all respects identical with the type collection of *Uromyces perigynius,* which was also on *C. intumescens,* but in the latter the large green perigynia also bore sori as well as the leaves, which unusual but incidental fact suggested the name. The similarity of this species with the form having aecia on *Solidago* was pointed out in 1903,[37] but for precautionary reasons it was thought best at that time to give the latter a separate name, *U. Solidagini-Caricis* Arth. This name now becomes a synonym of the former, or may be used to indicate the biological race with aecia on *Solidago.* The type host of this form has been determined as *C. deflexa,* and not *C. varia* as originally stated.

It is further probable that the form on *Carex scoparia* bearing the name *U. caricina* Peck, which often shows larger spores, should be referred to *U. perigynius,* the last being the oldest name of the three. A collection of this on *C. scoparia* was sent by Professor Fraser, from Pictou, Nova Scotia, and sown on *Lysimachia terrestris,* without infection. Its possible relation to the *Aster-Solidago* group did not come to mind soon enough to put the matter to a test.

22. UROMYCES JUNCI (Desm.) Tul., on *Juncus balticus* Willd. collected at Kulm, N. Dak., by Dr. J. F. Brenckle was sown April 14 on *Carduus Flodmanii, Arnica* sp., *Grindelia squarrosa, Ambrosia trifida,* and *Sidalcea oregana,* with infection only upon the first, showing pycnia April 29, and aecia May 4. Another sowing

[37] L. c.

May 10 on *Carduus Flodmanii* produced pycnia May 19 and aecia June 5. Another collection from the same place but taken at a different date was sown May 19 on *Carduus Flodmanii,* showing pycnia May 28 and aecia June 5. Three other collections of what appears to be the same rust on the same host, also sent from Kulm, N. Dak., by Dr. Brenckle but collected at different times were sown on *Carduus Flodmanii* (various dates), and one of these was also sown upon eighteen other species of hosts, all with no infection. Still another collection on *J. balticus* from Granby, Colo., sent by Mr. E. Bethel was sown on *Carduus Flodmanii* without infection.

The results here given appear to support the suggestion made in the last report[38] that this species is composed of races. The failure to infect *Pulicaria* with American material, as there stated, seems to indicate that American and European forms represent different races. The failure to infect *Carduus* with some of the sowings was also doubtless due to the existence of races. Mr. Bethel has since suggested that his collection from Granby is probably connected with aecia on *Arnica,* and both Mr. Bethel and Dr. Brenckle are of the opinion that there is a form of this species with aecia on *Ambrosia psilostachya.*

23. UROMYCES ASTRAGALI Sacc., on *Aragallus Lamberti* (Pursh) Greene (*Oxytropis Lamberti* Pursh), collected by Mr. E. Bethel at Leyden, Colo., was sown on *Euphorbia Cyparissias,* without result.

A collection bearing uredinia (*Uredo Oxytropi* Peck) on *Aragallus Lamberti* (Pursh) Greene, sent by Mr. Bethel from Boulder, Colo., was sown September 30, on *Astragalus carolinianus,* giving rise to uredinia that were first noticed October 22.

A collection bearing uredinia on *Astragalus sulphurescens* Rydb., sent by Mr. E. Bethel, from Boulder, Colo., was sown Sept. 30, on *A. carolinianus,* and on October 22, uredinia were observed, although they may have appeared somewhat earlier.

We have yet made no appreciable headway toward ascertaining the aecial condition of this rust, but the present cultures do show that the *Oxytropis* rust, which has usually been kept distinct, is

[38] Mycologia 2: 220. 1910.

identical with the widespread *Astragalus* rust. The species is one that does not readily produce teliospores.

24. UROMYCES MEDICAGINIS Pass., on *Medicago sativa* L., was sent by Mr. H. S. Coe, from Ames, Iowa. Urediniospores were sown September 26, on *Medicago sativa* in the greenhouse, and uredinia began to appear October 8. On November 14, uredinia from this culture were sown on *Medicago sativa, Trifolium pratense, T. medium,* and *T. repens,* giving uredinia on the first December 3, but with no infection of the *Trifolium* plants.

The aecia of *Medicago* rusts are not definitely known. In Europe a form usually assumed to be the same occurs on *Trifolium pratense,* and this was made by Schröter to infect *Euphorbia Cyparissias.* This form has not been detected in America. The present culture seems to show that the *Medicago* rust will not pass over to *Trifolium,* at least by means of urediniospores.

25. GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE Schw., on *Juniperus virginiana* L., collected by Dr. F. D. Kern in the vicinity of Lafayette, Ind., was sown April 7, on *Malus Malus,* giving numerous pycnia April 19, but the leaves matured before aecia were formed.[39]

26. GYMNOSPORANGIUM CLAVIPES C. & P., on *Juniperus sibirica* Burgsd., was sent by Dr. J. J. Davis, from Wind Lake, Wis., and sown May 3, on *Amelanchier erecta* and *Crataegus tomentosa,* giving numerous pycnia on both hosts May 16, and equally numerous aecia June 6, for the first host and June 11, for the second.

Aecia from this culture on *Amelanchier erecta* were used to sow June 7, on a small plant of *Juniperus sibirica,* and many finely developed telia appeared in May 1911, the exact date not recorded.[40]

These cultures are interesting in showing that the telia mature in the spring following infection, and do not require an additional year as some other species of *Gymnosporangium* do.

27. GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) DC., on *Juni-*

[39] For previous cultures see Jour. Myc. 12: 13. 1906; 13: 200. 1907; 14: 17. 1908; and Mycol. 1: 238. 1909.

[40] For previous cultures see Jour. Myc. 14: 18. 1908; Mycol. 1: 239. 1909; and 2: 229. 1910.

perus sibirica Burgsd., was sent by Mr. E. Bethel, from Boulder, Colo., and sown April 7, on the young fruit of *Pyrus communis,* which fell off before time for infection to show, and also on the leaves of *Amelanchier erecta* and *Crataegus punctata.* On the *Crataegus* a few pycnia showed April 15, but no aecia developed. On the *Amelanchier* numerous pycnia appeared April 13, and many aecia April 25.[41]

28. GYMNOSPORANGIUM NIDUS-AVIS Thaxt., on *Juniperus virginiana* L., was sent from Washington, D. C., by Dr. Haven Metcalf, and sown April 16, on leaves of *Cydonia vulgaris,* giving a few pycnia May 2, and also on the young fruit of *Amelanchier vulgaris,* giving a few pycnia first noticed May 24. In both instances no further development occurred.[42]

29. GYMNOSPORANGIUM CORNUTUM (Pers.) Arth., on *Juniperus sibirica* Burgsd., sent from Palmer Lake, Colo., by Mr. E. Bethel, was sown May 18 on *Sorbus americana, Aronia arbutifolia,* and *Amelanchier erecta.* Infection was secured only on the *Sorbus,* the pycnia being produced in abundance but tardily, and the date was not taken. The plant did not thrive, and no aecia matured, although on August 16 they were showing.[43]

30. GYMNOSPORANGIUM DAVISII Kern, on *Juniperus sibirica* Burgsd., sent by Dr. J. J. Davis from Wind Lake, Wis., was sown May 3, on *Aronia arbutifolia, A. nigra, Sorbus americana, Amelanchier erecta* and *Crataegus tomentosa,* without results. Another sowing was made May 12, on the two species of *Aronia,* which resulted in a few pycnia on *A. nigra,* showing May 27. Still another sowing on *A. arbutifolia* was made May 18, and gave a few pycnia May 25. In neither instance did aecia develop.[44] It is probable that the conditions under which the cultures are made in the greenhouse are not favorable for this rust.

31. GYMNOSPORANGIUM BETHELI Kern, on *Juniperus scopulorum* Sarg., sent by Mr. E. Bethel from Boulder, Colo., was sown

[41] For previous cultures see Jour. Myc. 14: 18. 1908; and Mycol. 1: 239. 1909.

[42] For previous cultures see Jour. Myc. 14: 19. 1908; and Mycol. 2: 230. 1910.

[43] For previous cultures see Mycol. 1: 240. 1909; and 2: 230. 1910.

[44] For previous cultures see Mycol. 1: 241. 1909, where an error was made in assuming that this species occurs in Europe; see also Mycol. 2: 216. 1910.

April 16, on *Crataegus cerronis* A. Nels., giving rise to numerous pycnia April 25, and equally numerous aecia May 23.[45]

32. GYMNOSPORANGIUM NELSONI Arth., on *Juniperus virginiana* L., sent by Professor R. A. Harper from Merrimack, Wis., was sown May 2, on *Amelanchier erecta, Cydonia vulgaris* and *Malus coronaria*. Infection was only on *Amelanchier,* showing an abundance of pycnia May 11, and equally numerous aecia June 8.[46] This rust is not often seen east of the Rocky Mountains. The witches' brooms which are produced have a general resemblance to those of *G. nidus-avis,* and it may sometimes be confused with that species.

33. CRONARTIUM QUERCUS (Brond.) Schröt. Aecia (*Peridermium Cerebrum* Peck) on *Pinus virginiana* Mill., were sent by Mr. W. H. Long, from the vicinity of Washington, D. C., and sown April 28, on *Quercus rubra.* The first appearance of uredinia was not recorded, but on May 20, a few uredinia and many telia were observed.[47]

34. MELAMPSOROPSIS ABIETINA (A. & S.) Arth., on *Ledum groenlandicum* Oeder, sent by Professor W. P. Fraser from Pictou, Nova Scotia, was sown June 15 on *Picea Mariana* (Mill.) B. S. P., giving numerous pycnia June 23, and aecia about August 12. This connection was first suggested by the field observations of Anton de Bary in the Alps, and by him proven by means of cultures in 1879.[48] A number of field observations by other mycologists were recorded, tending to fortify the result, but no other cultures were made until 1901, when Klebahn[49] verified the work of de Bary.

The probable connection of *Ledum* and *Picea rusts* in America was discussed by Professor W. G. Farlow in 1885,[50] based largely

[45] For previous cultures see Jour. Myc. 14: 23. 1908; Mycol. 1: 240. 1909; and 2: 230. 1910.

[46] For previous cultures see Jour. Myc. 13: 203. 1907; 14: 18. 1908; and Mycol. 1: 239. 1909. Studies published by Dr. F. D. Kern (Bull. N. Y. Bot. Gard. 7: 448. Oct. 1911) since this article went to press show that the form used in this culture, and also in the previous ones here referred to, has been erroneously referred to *G. Nelsoni,* it should be called *G. juvenescens* Kern.

[47] For previous cultures see Jour. Myc. 13: 194. 1907.

[48] Bot. Zeit. 37: 802. 1879.

[49] Zeitschr. Pflanzenkr. 12: 17. 1902.

[50] Proc. Amer. Acad. Sci. 20: 320. 1885.

upon his observations in the White Mountains of New Hampshire, but at that time too little study had been given to the morphological characters of the species inhabiting these two host genera to permit of accurate determination of the various collections, and the conclusions were consequently misleading.

The studies of Dr. F. D. Kern and the writer[51] a few years since showed that the American aecia previously referred to this species really belonged elsewhere, and that no genuine aecia of the species had been collected in America in all probability. After completing the cultures here recorded some of the resulting material was sent to Professor Fraser, and with a knowledge of the appearance and habit of the aecia thus acquired he was able to go into the field and gather excellent specimens.[52] The reason they have not been taken before by American collectors is doubtless due to their somewhat inconspicuous and evanescant character.

SUCCESSFUL CULTURES REPORTED NOW FOR THE FIRST TIME:—The following species have never before been cultivated, in America or elsewhere, so far as the writer knows.

1. PUCCINIA CRANDALLII Pam. & Hume on *Festuca confinis* Vasey collected by Mr. E. Bethel, at Boulder, Colo., on March 19, 1910, was sown April 21, on *Symphoricarpos racemosus, Grindelia squarrosa, Hydrophyllum capitatum* and *Arnica* sp., with infection only on the first. The pycnia began to appear May 9, and aecia May 26, neither in abundance. This was an unsuspected result, and immediately upon detecting evidence of infection, a second sowing was made upon another plant of *Symphoricarpos racemosus* (May 10), which yielded more pronounced results. Pycnia began to appear in ten days (May 20), and aecia in eleven days more (May 31), both well formed and numerous.

A second lot of this rust, on *Festuca confinis* Vasey, was received from Professor A. O. Garrett, collected in City Creek Canyon, Salt Lake City, Utah, April 10, 1910, and sown on the same date as the previous sowing, May 10. Pycnia began to show May 20, and aecia June 6.

[51] Bull. Torrey Club 33: 429, 430. 1906.
[52] Cf. Mycologia 3: 69. 1911.

The results of these cultures agree perfectly with *Aecidium abundans* Peck which was first collected in Colorado, on *Symphoricarpos oreophilus,* the exact locality not being stated.

2. PUCCINIA QUADRIPORULA Arth., on *Carex Goodenovii* J. Gay, collected by the writer in the type locality at Isle au Haut, Me., was sown April 18 on *Iris versicolor, Boehmeria cylindrica,* and *Rudbeckia laciniata,* with no infection. Again April 26 it was sown on *Myrica cerifera, Lysimachia terrestris, Macrocalyx Nyctelea, Polemonium reptans, Apocynum cannabinum, Senecio lugens,* and *Aster paniculatus,* with infection only on the last, pycnia being first noticed May 13, and aecia appearing May 17, neither very abundant.

Field observations seemed to connect this rust with aecia on *Iris,* but previous attempts at cultures had given no certain evidence.[53] The results this year appear beyond question. No other *Carex* rust grew in the vicinity of the spot where the collection was made. The material used shows only the characteristic rust. The aecia obtained, however, are both in gross and minute characters indistinguishable from those of *P. Caricis-Asteris* Arth. These facts make the status of the species enigmatical. The marked diagnostic characters of *P. quadriporula* and *P. Caricis-Asteris* lie in the urediniospore. The former has a somewhat larger urediniospore, more usually globose, and with four, often three, equatorial pores, while the latter has a smaller urediniospore, more ellipsoid or elongated, and with two superequatorial pores. The pore characters are markedly dissimilar, and without intergradations.

Another collection with the spore characters of *P. quadriporula,* made by Professor W. P. Fraser, at Pictou, Nova Scotia, on *Carex brunnescens* (Pers.) Poir., was sown April 11, and again May 6, on *Iris versicolor, Urtica gracilis,* and *Ribes floridum,* with no infection.

3. PUCCINIA LITHOSPERMI E. & K., on *Evolvulus pilosus* Nutt., collected at Amarillo, Texas, by W. H. Long, was sown April 15, on the same species of host, and produced a scanty infection. Pycnia were not observed until May 2; aecia began to appear

[53] See Mycol. 1: 230. 1909.

May 6. The result shows that the species is eugyrinious and autoecious.

4. UROMYCES ACUMINATUS Arth., on *Spartina Michauxiana* A. S. Hitch. (usually listed as *S. cynosuroides*), collected by Dr. J. F. Brenckle at Kulm, N. D., was sown April 28 on *Steironema ciliatum* and *Polemonium reptans,* with abundant infection on the latter only, showing pycnia May 9, and aecia May 14.

A similar collection made by Mr. E. Bethel in the foothills of Colorado was sown May 12, on *Steironema ciliatum, Hydrophyllum capitatum, Phlox divaricata,* and *Polemonium reptans,* with very abundant infection only on the last, showing pycnia May 20, and aecia May 26. Another collection made at Fair Oaks, Ind., by Messrs. F. D. Kern and T. Billings, was sown one week later on the same hosts, but gave no infection, doubtless due to the lateness of the season.

These results bear out the field observations of Professor Guy West Wilson, as stated in the report for 1909.[54] The aecial stage is known in literature as *Aecidium Polemonii* Peck, and occurs on species of *Phlox* as well as on *Polemonium.*

5. COLEOSPORIUM VERNONIAE B. & C. Freshly gathered leaves of *Pinus taeda* L., bearing *Peridermium carneum* Bosc, gathered by Mr. O. F. Burger at Gainesville, Fla., May 18, 1910, were suspended on May 21, over potted plants of *Veronia crinita, Elephantopus carolinianus* and *Lacinaria scariosa.* Contrary to expectation uredinia began to show in abundance June 6 on the *Veronia* only. Numerous telia began to mature by August 16.

6. MELAMPSORA ALBERTENSIS Arth., on *Populus tremuloides* Michx., was sent by Mr. E. Bethel on three different dates, collected at different places in the foothills of Colorado, and all showing telia in resting condition. The first collection was sown April 20, on *Larix laricina* and *Pseudotsuga mucronata,* giving infection on the latter only, showing an abundance of pycnia May 2, and an equal abundance of aecia May 9. The second collection (from Plainview, Colo.), was also sown April 20, on the same two hosts, but without results. Later on, May 18, duplicate sowings were made. This time the *Larix* remained free, and the *Pseudotsuga* after a long interval was found to have been infected,

[54] See Mycol. 2: 222. 1910.

the pycnia and aecia being first noticed June 6. The third collection was sown May 19, on the same hosts, with infection only on *Pseudotsuga*, numerous pycnia showing May 31, and equally numerous aecia June 9.

The aecia on *Pseudotsuga* were first brought to my attention by Professor E. W. D. Holway, who sent a collection from Beaver River valley, B. C., in 1907. This collection was described by the writer, and named *Caeoma occidentale*.[55] The following year Mr. E. Bethel sent collections from Eldorado Springs, Colo., and in 1909 he sent other collections from Eldorado Springs, and also from Tolland and Golden. From observations made at these places Mr. Bethel suggested that the connection between the *Caeoma* on *Pseudotsuga* and the *Melampsora* on *Populus* was unquestionable. The aecial stage is doubtless rather common throughout the range, but it is so inconspicuous and evanescent that it has been very little collected.

SUMMARY

The following is a complete list of the successful cultures made during the year 1910. It is divided into two series, species that have previously been grown in cultures and reported by the writer or other investigators, and species whose culture is now reported for the first time.

A. Species Previously Reported

1. *Puccinia Grossulariae* (Schum.) Lagerh.—Teliospores from *Carex tenuis* Rudge and from *C. pallescens* L., sown on *Ribes Cynosbati* L.

2. *Puccinia Peckii* (DeT.) Kellerm.—Teliospores from *Carex lanuginosa* Michx., sown on *Onagra biennis* (L.) Scop., and from *C. trichocarpa* Muhl., sown on *O. biennis* (L.) Scop. and *Meriolix serrulata* (Nutt.) Walp.

3. *Puccinia Caricis-Solidaginis* Arth.—Teliospores from *Carex scoparia* Schk., sown on *Euthamia graminifolia* (L.) Nutt.

4. *Puccinia Caricis-Asteris* Arth.—Teliospores from *Carex festiva* Dewey, sown on *Aster adscendens* Lindl.

[55] Bull. Torrey Club 34: 591. 1907.

5. *Puccinia Opizii* Bubák.—Teliospores from *Carex siccata* Dewey, sown on *Lactuca canadensis* L. and *L. sativa* L.

6. *Puccinia universalis* Arth.—Teliospores from *Carex stenophylla* Wahl., sown on *Artemisia dracunculoides* Pursh.

7. *Puccinia Caricis* (Schum.) Schröt.—Teliospores from *Carex aristata* R. Br. and *C. stricta* Lam., sown on *Urtica gracilis* Ait.

8. *Puccinia angustata* Peck.—Teliospores from *Scirpus atrovirens* Muhl., sown on *Lycopus americanus* Muhl.

9. *Puccinia Andropogonis* Schw.—Teliospores from *Andropogon virginicus* L., sown on *Pentstemon hirsutus* (L.) Willd. and from *A. scoparius* Michx., sown on *Pentstemon alpinus* Torr.

10. *Puccinia pustulata* (Curt.) Arth.—Teliospores from *Andropogon furcatus* Muhl., sown on *Comandra umbellata* (L.) Nutt.

11. *Puccinia amphigena* Diet.—Teliospores from *Calamovilfa longifolia* (Hook.) Hack., sown on *Smilax hispida* Muhl.

12. *Puccinia Muhlenbergiae* Arth. & Holw.—Teliospores from *Muhlenbergia racemosa* (Michx.) B. S. P., sown on *Callirrhoe involucrata* (T. & G.) A. Gray.

13. *Puccinia Rhamni* (Pers.) Wettst.—Teliospores from *Calamagrostis canadensis* (Michx.) Beauv., sown on *Rhamnus alnifolia* L'Her.

14. *Puccinia poculiformis* (Jacq.) Wettst.—Teliospores from *Agropyron tenerum* Vasey, *Sitanion longifolium* J. G. Sm., and *Agrostis alba* L., sown on *Berberis vulgaris* L.

15. *Puccinia subnitens* Diet.—Teliospores from *Distichlis spicata* (L.) Greene, sown on *Chenopodium album* L.

16. *Puccinia Jamesiana* (Peck) Arth.—Teliospores from *Atheropogon curtipendulus* (Michx.) Fourn., sown on *Asclepias syriaca* L.

17. *Puccinia Seymouriana* Arth.—Teliospores from *Spartina Michauxiana* A. S. Hitchc., sown on *Cephalanthus occidentalis* L.

18. *Puccinia Stipae* Arth.—Teliospores from *Stipa spartea* Trin., sown on *Aster ericoides* L., *A. Novae-Angliae* L., *A. multiflorus* Ait., and *Solidago canadensis* L., from *Stipa* sp., sown on *Aster Novae-Angliae* L., and *Grindelia squarrosa* (Pursh) Dunal, and from *Koeleria cristata* (L.) Pers., sown on *Senecio lugens* A. Gray.

19. *Puccinia argentata* (Schultz) Wint.—Aeciospores from *Adoxa Moschatellina* L., sown on *Impatiens aurea* Muhl.

20. *Puccinia Absinthii* DC.—Teliospores from *Artemisia* sp., sown on *A. dracunculoides* Pursh.

21. *Uromyces perigynius* Halst.—Teliospores from *Carex intumescens* Rudge, sown on *Aster paniculatus* Lam., and from *C. deflexa* Hornem., sown on *Solidago rugosa* Mill., and *Aster ericoides* L.

22. *Uromyces Junci* (Desm.) Tul.—Teliospores from *Juncus Balticus* Willd., sown on *Carduus Flodmanii* Rydb.

23. *Uromyces Astragali* Sacc.—Urediniospores from *Aragallus Lamberti* (Pursh) Greene, and from *Astragalus sulphurescens* Rydb., sown on *Astragalus carolinianus* L.

24. *Uromyces Medicaginis* Pass.—Urediniospores from *Medicago sativa* L., sown on same host.

25. *Gymnosporangium Juniperi-virginianae* Schw.—Teliospores from *Juniperus virginiana* L., sown on *Malus Malus* (L.) Britt.

26. *Gymnosporangium clavipes* C. & P.—Teliospores from *Juniperus sibirica* Burgsd., sown on *Amelanchier erecta* Blanch., and *Crataegus tomentosa* L., and aeciospores from *Amelanchier erecta* Blanch., sown on *Juniperus sibirica* Burgsd.

27. *Gymnosporangium clavariaeforme* (Jacq.) DC.—Teliospores from *Juniperus sibirica* Burgsd., sown on *Amelanchier erecta* Blanch., and *Crataegus punctata* Jacq.

28. *Gymnosporangium nidus-avis* Thaxt.—Teliospores from *Juniperus virginiana* L., sown on *Cydonia vulgaris* Pers., and *Amelanchier vulgaris* Moench.

29. *Gymnosporangium cornutum* (Pers.) Arth.—Teliospores from *Juniperus sibirica* Burgsd., sown on *Sorbus americana* Marsh.

30. *Gymnosporangium Davisii* Kern.—Teliospores from *Juniperus sibirica* Burgsd., sown on *Aronia arbutifolia* (L.) Medic., and *A. nigra* (Willd.) Britt.

31. *Gymnosporangium Betheli* Kern.—Teliospores from *Juniperus scopulorum* Sarg., sown on *Crataegus cerronis* A. Nels.

32. *Gymnosporangium Nelsoni* Arth.—Teliospores from *Juniperus virginiana* L., sown on *Amelanchier erecta* Blanch.

33. *Cronartium Quercus* (Brond.) Schröt.—Aeciospores from *Pinus virginiana* Mill., sown on *Quercus rubra* L.

34. *Melampsoropsis abietina* (A. & S.) Arth.—Teliospores from *Ledum groenlandicum* Oeder, sown on *Picea Mariana* (Mill.) B. S. P.

B. Species Reported Now for the First Time

1. *Puccinia Crandallii* Pam. & Hume.—Teliospores from *Festuca confinis* Vasey, sown on *Symphoricarpos racemosus* Michx.

2. *Puccinia quadriporula* Arth.—Teliospores from *Carex Goodenovii* J. Gay, sown on *Aster paniculatus* Lam.

3. *Puccinia Lithospermi* E. & K.—Teliospores from *Evolvulus pilosus* Nutt., sown on same species of host.

4. *Uromyces acuminatus* Arth.—Teliospores from *Spartina Michauxiana* A. S. Hitch., sown on *Polemonium reptans* L.

5. *Coleosporium Vernoniae* B. & C.—Aeciospores from *Pinus taeda* L., sown on *Vernonia crinita* Raf.

6. *Melampsora albertensis* Arth.—Teliospores from *Populus tremuloides* Michx., sown on *Pseudotsuga mucronata* (Raf.) Sudw.

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BOTRYOSPHAERIA ON COTTON BOLLS

C. W. Edgerton

Among the fungi of minor importance on cotton bolls in the southern states is a pyrenomycete which has been provisionally referred to *Botryosphaeria fuliginosa* (Mongeot & Nestler) Ellis & Ev. This fungus is not common on cotton but is occasionally picked up. The first collection on this host seems to have been made by Atkinson in Alabama some years ago. Atkinson's material was sent to Massee and was determined by him as *Botryosphaeria Berengeriana* De Not.[1] But as Ellis and Everhart list this name as a synonym of *Botryosphaeria fuliginosa*, the latter name will be used in this article. It is probable that this name is not the correct one, but the question of nomenclature will not now be considered. Atkinson's material has also been examined by the writer and found to be identical with material collected by him.

Having found this pyrenomycete on cotton bolls in Louisiana, a study of its life history was commenced in order to see if it had any connection with any of the imperfect fungi which are instrumental in causing boll rots. On account of the somewhat similar appearance of the boll affected by the *Botryosphaeria*, to one affected by *Diplodia gossypina*, it was thought that there might be some connection between the two. This seemed all the more possible because Shear had reported *Sphaeropsis* and *Diplodia* forms as connected with *Botryosphaeria*.[2] However, this was not found to be the case. While the *Botryosphaeria* on cotton bolls has an imperfect form in its life history, it is quite distinct from *Diplodia gossypina*.

Two stages of the fungus have been found, a pycnidial stage belonging to the form genus *Macrophoma*, and the perfect or

[1] Atkinson, G. F., Some fungi from Alabama, Bull. Cornell University, 3: 11. 1897.

[2] Shear, C. L., Life History of *Melanops Quercuum* (Schw.) Rehm forma *Vitis* Sacc. (abstract), Science, n. s. 31: 748. 1910.

ascogenous stage. The pycnidial stage occurs during the summer and is followed by the ascogenous stage in the fall. A boll affected by this fungus turns black, dries up, and becomes covered with the fruiting stages.

The pycnidia develop profusely on the surface of the diseased boll, usually almost superficial, though sometimes they may have the base slightly surrounded by fungous or host tissue. They are black in color and about $110–300 \times 140–210\,\mu$ in size. The spores are developed abundantly on short conidiophores and are pushed out of the pore at the apex of the pycnidium. If weather conditions are favorable, these spores remain in white strings protruding from the pycnidia. The spores are hyaline, one-celled, from cylindric to slightly ellipsoid or ovoid, coarsely granular, and $14–33 \times 7–10\,\mu$ in size, averaging about $21–25 \times 8\,\mu$. The spores are never septate nor dark-colored and are much more variable in shape and size than those of *Diplodia gossypina.*

The perithecia are borne in a way similar to the pycnidia and are quite similar in appearance. They are black in color and are about $190–360 \times 250–320\,\mu$ in size. A short beak may be present or lacking; if present, it may have a length up to $100\,\mu$. The asci are fairly abundant in the perithecia, though not crowded. They are large, about $100–130 \times 20–25\,\mu$, and have very thick walls, especially near the apex. The ascospores are hyaline, ellipsoid, slightly granular, and about $20–27 \times 10–16\,\mu$ in size. The small threadlike paraphyses are very abundant.

The fungus has been cultured a number of times both from the conidia and the ascospores. A good growth develops on most of the ordinary culture media but as yet no spores of any kind have been produced in culture media.

To prove the identity of the two forms, inoculation experiments were tried. In the winter of 1909–10, a pure culture was obtained from conidia, and this was used during the summer of 1910 to inoculate a number of bolls in the field. The fungus is not a very active parasite under field conditions, so only a part of the bolls became affected. These, however, on which the inoculation was successful, developed the pycnidia abundantly and later in the season some of them developed perithecia and ascospores. Single asci were then transferred to acidified culture

media in plates and pure cultures were again obtained. In the winter of 1910–11, these cultures from ascospores were used to inoculate cotton bolls on plants in the greenhouse. These bolls became affected and developed the pycnidia and conidia. Other inoculations made direct from bolls covered with the pycnidial stage have developed the perithecial stage later in the season. As a result of these inoculations, the identity of the two stages is proven.

From this study, it seems questionable whether the *Botryosphaeria* that we have on cotton bolls in the south is really the same as the one that is so common on a large number of woody plants in all parts of the country. In a paper read before the American Association for the Advancement of Science in December, 1909, Shear produced evidence to show that the common form of *Botryosphaeria fuliginosa* is connected with a pycnidial stage with spores usually colored and sometimes septate, a stage that could belong to either *Sphaeropsis* or *Diplodia*. As the *Botryosphaeria* which we have on cotton bolls in the south is not connected with a *Diplodia*, it would look as if the cotton *Botryosphaeria* is specifically distinct from the common form.

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NEWS AND NOTES

Dr. W. A. Murrill, who left New York, October 13, for a collecting trip in Washington, Oregon, and California, reports very favorable conditions for the collection of fleshy fungi on the Pacific coast.

Dr. Mel. T. Cook has recently resigned his position as pathologist in Delaware Agricultural College to accept a similar position in Rutgers College, New Jersey.

Mr. A. B. Stout, of the University of Wisconsin, has been appointed director of the laboratories in the New York Botanical Garden to succeed Mr. Fred J. Seaver, who has been transferred to a curatorship.

Professor R. A. Harper is conducting a series of seminars for the benefit of the graduate students of Columbia University, the subject considered being the reproduction of the higher fungi. The first of the series, which was held in the main laboratory of the New York Botanical Garden, Saturday, November 4, consisted of an introduction covering some of the earliest literature of the subject.

Professor J. C. Arthur and Dr. Frank D. Kern spent a month during the past summer on a field trip in Colorado. They were chiefly interested in observing and collecting the rusts, especially those heteroecious forms of which the life-histories are still unknown. They report that the trip was very successful and satisfactory. They were accompanied on several expeditions by Professor E. Bethel, of the East Denver High School, who rendered much valuable assistance.

A New Paint-destroying Fungus.—Mr. George Massee in the

Bulletin of Miscellaneous Information of the Royal Botanic Gardens, Kew, England, No. 8 of this year, describes a new fungus (*Phoma pigmentivora* Mass.) which grows on fresh paint. The fungus grows best in hothouses, high temperatures and constant humidity being especially conducive to its development.

The fungus appears as numerous, small, rose-colored specks in the white paint about a month after it has been applied. These spots increase in size and change to a purple or dark-red color suggesting the idea of blood having been sprinkled on the paint. The discolored areas spread and finally form effused patches several inches in diameter. The fruit of the fungus appears as minute blackish-red warts. One firm of painters during the present year lost over £200 in consequence of the appearance of the fungus in a large number of cucumber-houses painted with expensive protective paint.

The spores germinate in pure linseed oil but the mycelium remains colorless and produces no fruit. No germination takes place when the spores are sown in pure white lead. The red color suggests that the white carbonate of lead undergoes some chemical change induced by the presence of the fungus resulting in the formation of oxide of lead. The presence of two per cent. of carbolic acid in paint completely arrests the development of the fungus.

This is another illustration of the growth of certain fungi under conditions which would naturally be thought to be toxic to any living plant.—*F. J. Seaver.*

The Development of the Ascocarp of Lachnea scutellata.—In the Botanical Gazette for October, Dr. W. H. Brown gives the results of his studies of the development of the above named species, a common and widely distributed discomycete occurring on rotten wood.

The multinucleate ascogonium was found in the youngest plants which could be obtained to constitute the penultimate cell of the archicarp which when mature consists of about nine cells. No antheridium was found and it is probable that none was present. No fusion of nuclei was observed in the ascogonium or in the

ascogenous hyphae except in the tip where the nuclei fuse to form the primary nucleus of the ascus. The ascogenous hyphae grow out from the ascogonium and are multinucleate from the first. The tips of the smaller branches of the ascogenous hyphae are cut off and contain two nuclei. No uninucleate cells were observed. The two nuclei pass into the bent portion and divide. Walls are formed between the daughter nuclei thus forming a binucleate penultimate and uninucleate ultimate and antipenultimate cell which represents a typical hook. The penultimate cell gives rise to an ascus direct or divides to form other hooks.

The first division in the ascus is heterotypic and the second and third are similar to those in the ascogonium.—*F. J. Seaver.*

A Preliminary Report on the Yearly Origin and Dissemination of Puccinia graminis.—A paper by Mr. Fred J. Pritchard under the above title in the Botanical Gazette for September contains the record of the observations of the author of the paper for several years past, together with the results of recent experimental work on the germination of rusted wheat grains.

The absence of the barberry in several regions where *Puccinia graminis* is prevalent seems to indicate that the heteroecism of the fungus is merely facultative. While the existence of a perennial mycelium has been established for several of the rusts this has not been proven for *Puccinia graminis.*

Eriksson after extensive experiments in Sweden divides *Puccinia graminis* into several biological forms. His conclusions however have not been supported by Carleton's work in America.

The experiments of Pritchard show that *Puccinia graminis* passes readily from wheat, *Agropyron tenerum, A. repens, Hordeum jubatum* and *Elymus triticoides* to the barberry. His observations also seem to indicate that the aeciospores and uredospores are not carried to great distances by the wind.

The pericarp of rusted wheat grains is frequently filled with rust mycelium and pustules of teleutospores. Pieces of mycelium resembling rust were found in cells of the scutellum close to the growing plant. It is suggested as a possibility that the mycelium of the rust might in this way infect the young plant and later take on a virulent form.—*F. J. Seaver.*

Studies on the Tremellineae of Wisconsin.—In his studies of the Tremellineae of Wisconsin in the transactions of the Wisconsin Academy of Sciences, Arts and Letters, volume 16, part 2, E. M. Gilbert has brought together the species of the order from that state in such a way as to be of valuable service to the student of mycology and to the monographer of the group. He has included the descriptions of fifteen species, quoting the commonly accepted synonyms. He finds in addition species in *Tachaphantium, Tremella* and *Dacryomyces* which he thinks may be new and possibly new varieties of *Auricularia auricula, Dacryomyces deliquescens* and *Calocera cornea.* His conservatism in that he has refrained from giving them new names without further investigation is commendable.

Naematelia encephala which he states has not been reported before for this country was frequently collected by Mr. Ellis and was distributed by him in North American Fungi *1719*. Also *Naematelia nucleata* which according to Gilbert has apparently not before been reported from this country was issued by Mr. Ellis in North American Fungi *520*.

A more extended study of exsiccati would have enabled him to suggest additions to the synonymy of several species, as his account probably covers most of the species ordinarily found in the country.—*B. O. Dodge.*

A Biologic and Taxonomic Study of the Genus Gymnosporangium.—Volume 7, No. 26, of the Bulletin of the New York Botanical Garden, issued October 12, was entirely devoted to a paper under the above title by Dr. F. D. Kern, associate botanist in Purdue University Agricultural Experiment Station, Lafayette, Indiana. This subject is treated in two parts, the first being devoted to the biology of the genus and the second to its taxonomy.

Under the subject of the biology of the genus the life history of *Gymnosporangium* as compared with other rust genera, the general characters of the genus, nuclear history so far as it is known, and facts governing the distribution of the species are considered briefly. Under experimental investigation the author gives a brief account of the history of experimental work and the dis-

covery of heteroecism; he also discusses culture methods and the necessity for such work and then takes up an account of his own experimental work. This work was preceded by five seasons of culture work with the various species of the genus. Out of 33 species now recognized in their telial phases 26 have been available for culture work. Successful cultures were secured in 18 out of the 26 species tested. Of these 9 were verifications of life cycles previously known and 9 gave aecial and telial connections for the first time. During the course of the work 253 individual plant cultures were attempted and 25 species of trial hosts employed, belonging chiefly to the apple family. The pathologic and economic importance of the genus is considered at the close of the first part of the work.

In the taxonomic study of the genus the author prefers to retain the well-known name *Gymnosporangium* rather than to adopt the older name *Aecidium* which has come to be used strictly as a form-genus. The paper contains descriptions of 29 species which have full life cycles known, 4 known only in the telial phase and 7 known only in the aecial phase; a total of 40 species in all. Of these 4 represent new species and 9 are new combinations. The descriptions are preceded by two analytic keys, the one based on the aecia and the other on the telia. There are also two host keys, the first being a key to the hosts harboring the aecial phase and the second a key to the hosts harboring the telial phase.

The entire paper consists of 89 pages of text, 11 half-tone plates and 36 figures.—*F. J. Seaver.*

The Control of the Chestnut Bark Disease.—Haven Metcalf and J. F. Collins treat the subject in farmers bulletin No. 467, issued by the United States Department of Agriculture, October 28, 1911.

The total financial loss from this disease is now estimated at $25,000,000. The only known practical means of controlling the disease in a forest is to locate and destroy the advance infections as soon as they appear. Advance infections should be located by trained observers and destroyed by cutting and burning. Chestnut nursery stock should be rigidly inspected and

only perfectly healthy plants passed. The life of valuable ornamental trees may be greatly prolonged by promptly cutting out all diseased parts and covering cuts with tar. Spraying is of no use in stopping the fungus after it is once started. Diseased chestnut trees should be cut down and utilized as soon as possible. For the present the planting of chestnuts anywhere east of Ohio is not advised, but there is no apparent reason why chestnut orchards west of Ohio cannot be kept free from the disease.—*F. J. Seaver.*

The Blister Rust of White Pine.—Bulletin 206 of the Bureau of Plant Industry of the United States Department of Agriculture contains the results of the investigation of this disease by Mr. Perley Spaulding. The growth of the reforestation movement in America has caused a steady increase in the importation of young white pine stock, with the consequent danger of introducing destructive insect or fungus pests.

Cronartium ribicola, which was discovered in 1855, was later found to be only a stage of *Peridermium Strobi,* the blister rust of various species of *Pinus.* This fungus has been introduced from Europe into numerous localities in America.

The methods of preventing and combating this disease are as follows: stop importing five-leaved pines (for which the fungus has a preference) and *Ribes* (which constitutes the alternate host for this fungus) and raise these plants at home; keep five-leaved pines separated from *Ribes* if either is imported; where the disease is already present all diseased pines should be removed and burned; diseased *Ribes* bushes should also be removed and burned.

Rigid inspection of all imported stock, or the entire prohibition of the importation of five-leaved pines and *Ribes,* should be compelled by legislation.—*F. J. Seaver.*

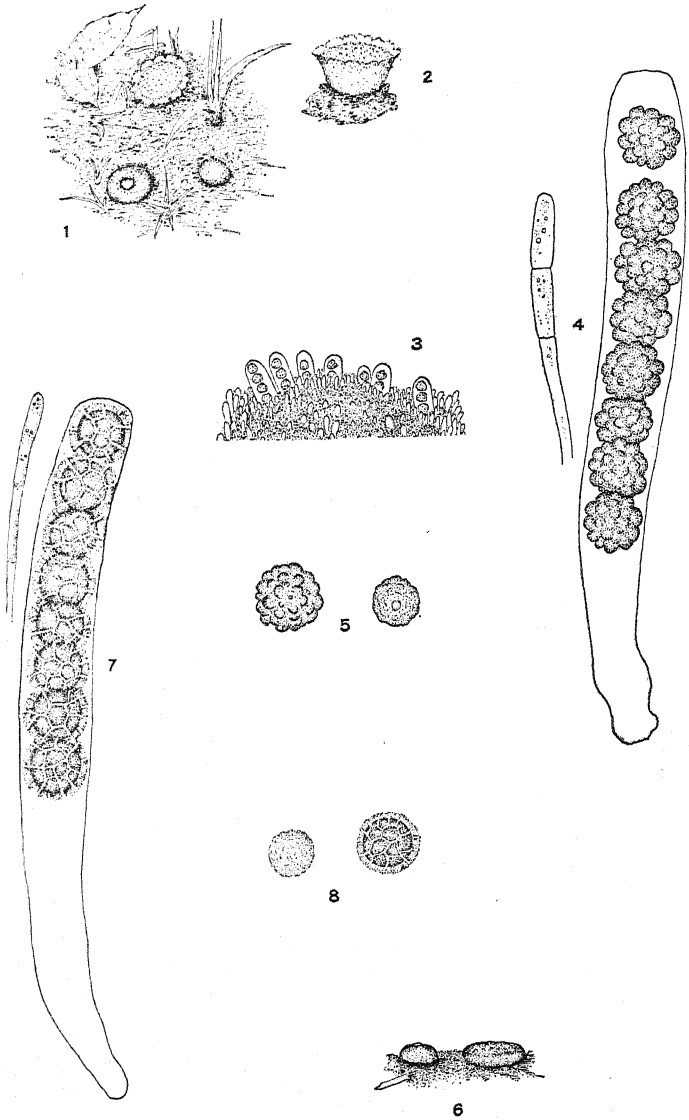
The Relation of Parasitic Fungi to the Contents of the Cells of the Host Plants (I. The Toxicity of Tannin).—The above is the title of an extensive paper by Dr. M. T. Cook and Mr. J. J. Taubenhaus published as Bulletin No. 91 of the Delaware Col-

lege Agriculture Experiment Station. The resistance of certain plants to the attack of disease-producing fungi has been often observed and discussed. It has been accounted for first by certain structural characters or impervious leaf surfaces and then by the assumption of a peculiar resistant type of cell due to physiological and consequently chemical differences *within* the cell. Now, the first of these explanations was early disproved by the researches of Ward and others while the idea of physiological resistance has not been investigated as much as its importance would seem to make desirable. Dr. Cook attacked this problem with the idea of discovering, if possible, to what extent the substance *tannin,* of almost universal occurrence among plants, may function in their immunity against fungous diseases. Later it is intended to extend the investigation to include the other cell constituents having a possible bearing upon such immunity.

The methods of study were well planned and carefully carried out. It consisted, briefly, in inoculating different types of culture media, containing varying amounts of tannin, with a large number of parasitic and saprophytic fungi known to produce plant disease. In general it was found that tannin inhibited the growth of the fungi and that this effect was more pronounced in the case of the parasites than with the saprophytes. Small amounts of tannin seemed to have a stimulative action upon growth and fruiting but usually from 0.1 per cent. to 0.4 per cent. tannin had a strong inhibitory effect. It was thought that the acidity of the tannin might account for its observed action upon the fungi but upon experimentation it appeared that even after neutralization with sodium hydroxide the tannic acid radicle still showed its characteristic inhibitions to a large extent. Different amounts of sugars and protein in the media had very little effect in reducing the toxicity of tannin.

The action of tannin upon the germination of the spores was found to be unfavorable if it were present in anything more than slight amounts. In toxic percentages the time necessary for germination was considerably increased. On the other hand, in smaller amounts tannin acted as a stimulant of germination. Some interesting tests were performed by placing cultures of certain fungi upon very thin cork sheets which had been treated

to remove all the tannin. After a certain time all of the fungi made their way through the cork films and infected the agar below. However, if such cork sheets were allowed to absorb tannin solutions and were then inoculated as before, the fungi were not able to penetrate the cork at all. It might be added that it was early observed that commercial tannin is slightly more toxic than the fresh extract of oak bark. All of these facts taken with the observations of others led the authors to believe that the presence of tannin in the host cells may often help to produce an immunity from the attacks of fungi.—*E. D. Clark.*



1–5. LAMPROSPORA TUBERCULATA SEAVER
6–8. LAMPROSPORA AREOLATA SEAVER

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THE GENUS LAMPROSPORA, WITH DESCRIPTIONS OF TWO NEW SPECIES

FRED J. SEAVER

(WITH PLATE 57, CONTAINING 8 FIGURES)

The genus *Lamprospora* was founded by De-Notaris in 1864, with *Ascobolus miniatus* Crouan, one of the globose-spored operculate cup-fungi as its monotype.

In 1869 Fuckel published the genus *Crouania* with *Crouania miniata* (Crouan) Fuckel as the type of the genus. This name is untenable, having been previously used for a genus of algae,[1] and in addition is antedated by the above name.

In 1889 the name *Barlaea* was proposed by Saccardo with *Crouania* Fuckel as a synonym. This name is also untenable, having been previously used for a genus of flowering plants.[2] Saccardo discovering this fact, later published the genus *Barlaeina* with *Barlaea* Sacc. as a synonym.

Lamprospora therefore appears to be the proper name to be used for the smaller plants of the globose-spored type of operculate discomycetes, except those which are commonly placed with the Ascobolaceae, through its priority of date and with the additional fact that two of the more recent generic names proposed are untenable for reasons mentioned above.

For several years past the writer has been interested in the col-

[1] Agardh, J. G., Alg. Mar. Med. 83. 1842.

[2] Reichenbach, H. G., Linnaea 41 : 54. 1877.

[Mycologia for January, 1912 (4: 1–44), was issued January 6, 1912].

lection and study of these minute but interesting plants and the recent collection of two apparently undescribed species has prompted the writing of the present paper. For the following reasons both the collection and study of the plants of this genus is difficult and unsatisfactory.

1. The plants are often so small that they are easily overlooked and for this reason seldom collected.

2. The descriptions of the known species are so fragmentary that in many cases they do not render the plants recognizable.

3. The type specimens preserved in the ordinary way are of little value since the plants, at best small, become much smaller on drying and are often lost with the crumbling earth on which they usually grow.

These difficulties are partly compensated by the fact that while the plants are very small the spores, as a rule, are unusually large. In addition to their large size they are often sculptured, the nature of the sculpturing furnishing valuable diagnostic characters. The type species of the genus has the spores covered with delicate, shallow reticulations. Other species have the spores marked with deep reticulations, sharp spines, minutely verrucose or coarsely tuberculate. In a number of species the spores are smooth and we must in such cases rely upon other diagnostic characters. In addition to the preservation of plants on the substratum for the study of gross characters in the ordinary way microscopic slides should be preserved, especially in those forms in which the spores furnish diagnostic characters. With careful drawings and descriptions from fresh material and specimens preserved in the above manner the species of the genus should be made recognizable.

The plants of this genus show rather close relationship with some of the Ascobolaceae both in the character of the spores and asci as well as in the protrusion of the asci above the surface of the hymenium, the latter character being the one on which the Ascobolaceae are distinguished from the Pezizaceae. To the writer it seems very doubtful if there is any morphological character by which these two families can be separated. The most natural classification of the true cup-fungi (Pezizales) to my

mind, is that proposed by Boudier,[3] *i. e.,* to separate them into the operculate and non-operculate forms. The former group would include those in which the asci open by an operculum or lid and the latter those in which the asci open by a pore. As pointed out by Boudier these characters are accompanied by numerous others which strongly suggest a natural division. This classification would throw together the Ascobolaceae and Pezizaceae unless some morphological character can be discovered on which they can be distinguished other than that which is commonly used. The occurrence of many of the Ascobolaceae on the dung of animals is a convenient character but there are so many exceptions that this can hardly be relied upon as a characteristic of the family. If the Ascobolaceae are kept distinct on the character usually employed, the protrusion of the asci, at least some of the species of the genus *Lamprospora* should be placed among the Ascobolaceae. Whether the entire genus should be transferred I am uncertain. To my mind the most natural thing would be to ignore the family distinctions of the Ascobolaceae and Pezizaceae and key out the genera regardless of this family distinction.

LAMPROSPORA De-Not. Comm. Critt. Ital. 1: 388. 1864

Crouania Fuckel, Symb. Myc. 320. 1869.
Barlaea Sacc. Syll. Fung. 8: 111. 1889.
Barlaeina Sacc. Syll. Fung. 14: 30. 1899.

Plants small, scarcely exceeding 5 mm. in diameter, concave, plane or slightly convex, usually bright-colored or more rarely pallid, fleshy, hymenium often roughened by the protruding asci; asci 8-spored, operculate; spores comparatively large, globose, at first smooth, at maturity often sculptured, verrucose, echinulate, reticulate or tuberculate or permanently smooth, hyaline; paraphyses numerous and usually clavate.

Type species, *Ascobolus miniatus* Crouan.

Lamprospora tuberculata sp. nov.

Plants small, 0.5–1 mm. in diameter, hymenium gradually expanding, at maturity plane or slightly convex, bordered by a

[3] Boudier, E., On the importance that should be attached to the dehiscence of asci in the classification of the discomycetes. Grevillea 8: 45–48. 1879.

delicate fringe, pale orange; hymenium roughened by the protruding asci; asci cylindric, operculate, 15–18μ in diameter; spores globose, at first smooth with a large oil-drop, gradually becoming roughened, at maturity coarsely tuberculate, about 16μ in diameter, hyaline; paraphyses clavate (*pl. 57, f. 1–5*).

On damp soil among moss in open places; type collected near Yonkers, New York. The same species has been collected by the writer in New Jersey and by Mr. B. O. Dodge in Virginia.

Lamprospora areolata sp. nov.

Plants small, 0.5–1 mm. in diameter, at first globose opening rather irregularly, at maturity with the hymenium plane or slightly convex, more or less roughened by the ends of the asci, bright red; asci cylindric, 15–18μ in diameter, 8-spored; spores globose, at first smooth, with a large oil-drop, becoming rough at maturity deeply areolate, about 16μ in diameter; paraphyses clavate (*pl. 57, f. 6–8*).

On soil among moss in a beaten path in woods near Yonkers, New York.

Both the plants and the spores are similar to *Humaria calospora* Quél. as figured by Boudier in Ic. Myc. *pl. 400,* except that the spores are perfectly globose instead of ellipsoid.

CULTURES OF UREDINEAE IN 1911[1]

J. C. Arthur

The present article is the twelfth of a series of reports[2] by the writer upon the culture of plant rusts, extending through thirteen consecutive years. The preceding report for the year 1910, published in Mycologia for January, 1912, contained an unfortunate slip of the pen in the heading of a paragraph at the middle of page 13, where "*Grossulariae* (Schum.) Lagerh." should read *albiperidia* Arth. With this change, the discussion which follows reads correctly. The same error occurs on page 30, twelfth line from the bottom.

The very large majority of the sowings for each year are made during the months of April and May. Hot weather is inimical to the work, except for a few species. Throughout the year 1911 unusual high temperature prevailed; after the first week in May the thermometer ranged above 80° F. during the middle of the day for the remainder of the cultural season. Owing to an unfortunate delay in securing an assistant to prosecute the work, the first sowings were not made until April 19, and the work was scarcely well under way before the hot days began, making it nearly impossible to obtain germination of the spores, or in case of germination to obtain infection of the hosts.

The work of the season was conducted by Mr. Earl A. Trager, a junior high school student of South Bend, Ind., who was recommended by Miss Clara Cunningham, teacher of the natural sciences in the South Bend High School. Mr. Trager conducted the work admirably. He furthermore showed capacity for mastering the technique and for handling the problems involved which compared favorably with that of his more mature and

[1] Presented before the Botanical Society of America at the Washington meeting, December 27, 1911.

[2] See Bot. Gaz. **29**: 268–276; **35**: 10–23; Jour. Myc. **8**: 51–56; **10**: 8–21; **11**: 50–67; **12**: 11–27; **13**: 189–205; **14**: 7–26; Mycol. **1**: 225–256; **2**: 213–240; and **4**: 7–33. 1912.

experienced predecessors. The paucity of results is wholly ascribable to the lateness in beginning the work and to the unseasonable weather.

Only one direct excursion was made to supply material for this year's cultures. Early in March the writer, accompanied by Mr. Ray Stretch, a graduate of the Lafayette High School, who rendered efficient service and proved a keen observer, visited the region bodering the Mississippi Sound from Ocean Springs to Pass Christian, Miss., well known from the thorough field work and numerous publications of Professor S. M. Tracy, whose home is at Biloxi, between the two places mentioned. The special object in view was to secure material of *Gymnosporangium bermudianum,* the only autoecious species known belonging to this genus, both for culture and for morphological work. Hope was also entertained that fresh material of species of *Peridermium,* with field observations to assist in culture work, might be secured. The region was found to possess the fewest rusts, both in number of species and in their abundance, of any section yet visited for observational purposes.

Upon request a visit to Newfield, N. J., was made by Dr. Frank D. Kern, studying during the collegiate year at Columbia University, New York, accompanied by Mr. B. O. Dodge, a graduate student of the same institution. The object was to secure material of several species of *Gymnosporangium* for cultures. Newfield was chosen, as it was for many years the home of Mr. J. B. Ellis, and his collections show a number of hitherto poorly understood species, whose aecia are still unknown. Probably the most interesting of these is a small foliicolous form on the white cedar, recently described as *G. fraternum* Kern. A note found in the Ellis collection at the New York Botanical Garden gave evidence that it was common in a certain swamp twenty-five years ago. The particular spot was found, and the fungus secured. One day was spent in this vicinity, and seven species of *Gymnosporangium* were collected. Among these were *G. Ellisii,* whose aecial stage is suspected to be the rare *Roestelia hyalina,* and the recently named *G. effusum.* The last is a large form on branches, very destructive to the red cedar, and yet never issued in exsiccati. It is the only one collected on this trip from which infection was obtained.

An extended excursion, but too late for the season's cultures, was made by the writer and Dr. Frank D. Kern during August and September to the foothills of Colorado, between Boulder and Pueblo, and to some extent in the adjacent mountains. This is the richest rust flora, both in species and frequency of occurrence, yet encountered. The dryness of the atmosphere, which promotes the growth of the rust on the individual hosts, while checking the spread from plant to plant, makes the region an exceptionally fine one for field study of relationships between the alternate stages of heteroecious species. Our work was enormously promoted by assistance from Mr. E. Bethel, of Denver, whose exact, enthusiastic, and prolonged observations over the whole region visited cannot be too highly commended. The freedom with which he turned over for our use his most important discoveries and conclusions must unfortunately be inadequately repaid. It was due to his assistance that this excursion proved the richest in results by far of any yet undertaken, results that are only slightly reflected in this report, but have paved the way for important cultures in 1912.

On the eleventh of November, after a day of summer heat, a hurricane did great injury to the conservatory and greenhouse of the Experiment Station, in which many plants for the next season's experiments were growing. At about nine o'clock in the evening a large part of the glass in these houses, and in the offices and laboratories of the department of botany, was broken in by the violence of the wind. The heavy rain which was falling soon turned to snow, and the temperature dropped to many degrees below freezing. When the damage was detected at about eight o'clock the next morning, the plants were largely beyond recovery.

Hearty thanks are due to the following persons who contributed material for study: Mr. E. Bethel, Denver, Colo., heading the list with 87 collections; Messrs. E. W. Olive, Brookings, S. D., J. M. Bates, Red Cloud, Neb., J. Dearness, London, Ont., and W. P. Fraser, Pictou, Nova Scotia, each sent between 10 and 30 collections, while much smaller numbers were sent by Messrs. E. Bartholomew, Stockton, Kans., C. F. Baker, Claremont, Calif., J. F. Brenckle, Kulm, N. D., J. C. Blumer, Tucson,

Ariz., H. S. Coe, Ames, Iowa, H. M. Jennison, Crawfordsville, Ind., S. Kusano, Tokio, Japan, E. F. Smith, Hannaford, N. D., E. M. Wilcox, Lincoln, Neb., J. J. Wolf, Durham, N. C., and F. Vasku, Oberlin, Ohio. Seeds and living plants were also sent by a number of botanists to provide host plants of native species required in the work. To all these and to others who aided in the work of the year grateful acknowledgment is due and is hereby extended. The investigations were carried out under the auspices of the Indiana Experiment Station, and financed from the Adams fund.

During the present season 193 collections of material with resting spores and 37 collections with active spores were employed, from which 691 drop cultures were made to test the germinating condition of the spores. Out of the 193 collections with resting spores 156 failed to germinate, leaving 37 collections available for experimental tests. Altogether about 235 sowings were made and 32 infections obtained. All but three sowings were made on plants growing in pots in the greenhouse. The most important conclusions derived from a study of the results are given in the following paragraphs.

NEGATIVE RESULTS.—It has been customary in these reports to record sowings with germinating spores when no infections were obtained, to serve as a guide in selecting hosts for future attempts. This year only a few instances will be given, as all sowings made after the heated term began, May 8, are deemed too uncertain to be of value.

1. PUCCINIA TOSTA Arth., on *Sporobolus asperifolius* (Nees & Meyen) Thurb., collected at Denver Colo., by Mr. E. Bethel, was sown April 19, on *Atriplex confertifolia* and *Malvastrum coccineum*, with no infection. The day following a collection with same data from Delta, Colo., was sown on *Aesculus glabra* and *Xanthoxylum americanum*, and again, May 10, on ten other hosts, with no infection.

The resemblance of this rust and of its host to that of *Puccinia subnitens* Diet., on *Distichlis spicata*, is very marked, as seen in the field. The two species grow under the same conditions, often intermixed, and might be expected to have the same aecial

hosts, a possibility barely touched by the present attempt at culture.

2. PUCCINIA SCHEDONNARDI K. & S., on *Schedonnardus paniculatus* (Nutt.) Trel., collected at Stockton, Kans., by Mr. E. Bartholomew, was sown April 19, on *Aesculus glabra, Xanthoxylum americanum, Hydrophyllum capitatum, Sidalcea oregana, Callirrhoe involucrata,* and *Onagra pallida,* with no infection. Similar material in former years was sown on twenty-eight other species of hosts.[3]

3. GYMNOCONIA INTERSTITIALIS (Schl.) Lagerh. No attempts have been made, so far as the writer knows, to propagate any species of rust by means of its pycniospores, except one made by Dr. Frank D. Kern in 1910, and not heretofore reported. He sowed pycniospores from *Amelanchier erecta,* belonging to *Gymnosporangium clavariaeforme,* upon young leaves of *A. erecta* by pricking and otherwise mutilating the epidermis, but without results. It is well known that the growth of such spores soon ceases in a liquid culture the same as with any other rust spores, only sooner, as they are much smaller and contain less nutriment. But it has not been shown that they will not form a mycelium when suitably placed upon or within the tissues of a host plant. The prominent and abundant pycnia of the blackberry rust, which mature in advance of the aecia, seem especially favorable for such a trial. Pycniospores from *Rubus allegheniensis* taken when perfectly fresh were sown May 9 on young leaves of two different plants of the same species, which were well established in pots. The spores were not only placed on the surface of the partly grown leaves, but were also pricked into the tissues in places with a needle. This was done to imitate the probable dispersion of such spores by insects, for which the nectar secreted by the sori may have an attraction. No infection was obtained. Neither in this attempted culture nor in that by Dr. Kern was any examination made to ascertain what growth the pycniospores may have made.

SUCCESSFUL CULTURES SUPPLEMENTING PREVIOUS WORK.—The facts derived by growing the following species of rusts supple-

[3] See Bot. Gaz. 35: 11. 1903; Jour. Myc. 13: 193. 1907; 14: 11. 1908; Mycol. 1: 231. 1909; and 4: 10. 1912.

ment those obtained from previous cultures in this series or from cultures recorded by other American or European investigators.

1. PUCCINIA PECKII (DeT.) Kellerm., on *Carex lanuginosa* Michx., collected at Red Cloud, Neb., by Rev. J. M. Bates, was sown May 20 on *Onagra biennis* and *Meriolix serrulata,* with no infection on the latter, but with abundant pycnia on the former May 29, and aecia June 1.[4] Similar cultures on *Onagra biennis* were made from undetermined species of *Carex* collected by Mr. E. Bethel, at Denver, Colo., and by Dr. J. F. Brenckle, at Kulm. N. D.

2. PUCCINIA ANGUSTATA Peck, on *Scirpus cyperinus* (L.) Kunth, collected at London, Ont., by Mr. J. Dearness, was sown May 25 on *Lycopus americanus,* giving rise to pycnia first seen June 3, and aecia June 5.[5]

3. PUCCINIA PHRAGMITIS (Schum.) Körn., on *Phragmites communis* Trin., collected at Cowles, Neb., by Rev. J. M. Bates, was sown May 9 on *Rumex crispus,* giving rise to abundant pycnia and aecia first observed May 23.[6]

4. PUCCINIA CINEREA Arth., on *Puccinellia airoides* (Nutt.) Wats. & Coult., collected at Lewis Station, Colo., by Mr. E. Bethel, was sown May 10 on *Oxygraphis Cymbalaria,* giving rise to pycnia May 16, and an abundance of aecia May 20.[7]

5. PUCCINIA SUBNITENS Diet., on *Distichlis spicata* (L.) Greene, collected at Lewis Station, Colo., by Mr. E. Bethel, was sown May 2, on *Sarcobatus vermiculatus, Monolepis Nuttalliana, Cleome spinosa, Atriplex hastata,* and *Chenopodium album,* with no infection on the first two, but with numerous pycnia on the others, appearing May 11, 12 and 16, respectively, followed by aecia on the *Cleome* and *Atriplex,* on both appearing May 15.[8]

[4] For previous cultures see Bot. Gaz. 35: 13. 1903; Jour. Myc. 8: 52. 1902; 11: 58. 1905; 12: 15. 1906; 13: 195. 1907; Mycol. 1: 233. 1909; 2: 222. 1910; and 4: 15. 1912.

[5] For previous cultures see Bot. Gaz. 29: 273. 1900; Jour. Myc. 8: 53. 1902; 11: 58. 1905; 13: 196. 1907; 14: 14. 1908; Mycol. 1: 234. 1909; and 4: 17. 1912.

[6] For previous cultures see Bot. Gaz. 29: 269. 1900; Jour. Myc. 9: 220. 1903; 14: 15. 1908; and Mycol. 2: 225. 1910.

[7] For a previous similar culture see Mycol. 1: 246. 1909.

[8] For previous cultures see Bot. Gaz. 35: 19. 1903; Jour. Myc. 11: 54. 1905; 12: 16. 1906; 13: 197. 1907; 14: 15. 1908; Mycol. 1: 234. 1909; 2: 225. 1910; and 4: 18. 1912.

6. UROMYCES PECKIANUS Farl., on *Distichlis spicata* (L.) Greene, obtained in the field March 29, 1911, at Pictou, Nova Scotia, by Professor W. P. Fraser, was sown April 19 on *Tissa canadensis* and *Lepidium virginicum*, with no infection. Another collection with same data but obtained in the field April 13, 1911, was sown on *Bursa Bursa-pastoris, Lepidium virginicum, Corydalis montanum, Tissa canadensis, Cleome spinosa*, and *Atriplex hastata*, with no infection except on the last, which showed numerous pycnia May 16, and an abundance of aecia May 22. Still another collection with same data but obtained in the field April 27, 1911, was sown May 5 on *Chenopodium album* and on the same six hosts as the last, with infection only on *Atriplex*, showing pycnia May 17, and aecia May 29, both in abundance.

A former attempt at cultures with this species proved futile,[9] but Professor Fraser[10] met with better success in cultures made by himself during the same season of 1910. He was able to abundantly infect both *Atriplex hastata* and *Chenopodium album* from teliospores on *Distichlis spicata*. Material from his cultures was most generously sent to the writer. Since then he has sent material of his more extensive and important cultures of 1911, which need not be specifically mentioned here, although they strengthen the conclusions about to be stated.

A careful morphological study of herbarium material, both as collected in the field and as grown from cultures, shows no appreciable difference in the gross or microscopical characters between the several stages of *Puccinia subnitens* Diet. and *Uromyces Peckianus* Farl., except in one particular—the unilocular or bilocular condition of the teliospore. When the teliospore is two-celled, as in the *Puccinia*, it is correspondingly longer than, but essentially the same otherwise as the one-celled teliospore, found in the *Uromyces*. The aecia in their peridial cells and aeciospores, and the uredinia in their appearance and in their urediniospores, when taken by themselves are indistinguishable. The only character with which to separate the so-called two species is the presence or absence of a septum in the teliospore.

Both the *Puccinia* and the *Uromyces* show marked racial tendencies in the selection of aecial hosts, seemingly correlated with

[9] See Mycol. 4: 12. 1912.
[10] Mycol. 3: 72–74. 1911.

geographical position, but more information is needed regarding the races of the *Uromyces* before a full comparison can be instituted. Whether the aecia of the *Uromyces* ever occur upon any family other than the *Chenopodiaceae,* as do those of the *Puccinia,* yet remains uncertain, but it is confidently expected that such will be the case. In any event there is every reason, except that of nomenclatorial expediency, to consider *Puccinia subnitens* and *Uromyces Peckianus* telial races of one and the same species which in turn may be separable into geographical races in accordance with their selection of aecial hosts.

7. UROMYCES MEDICAGINIS Pass. The urediniospores from plants of *Medicago sativa* L., carried over the winter in the greenhouse, were sown March 8 on *Medicago sativa, Trifolium pratense, T. medium,* and *T. repens,* producing infection only on the first, uredinia showing March 22. A similar set of sowings was made April 28 on other plants of the same four hosts, with similar result, only the *Medicago* being infected, showing uredinia May 12. The work of 1910 is thus confirmed.[11]

8. GYMNOSPORANGIUM NIDUS-AVIS Thax., on *Juniperus virginiana* L., was sent by Dr. Frank D. Kern from Newfield, N. J., and sown May 4 on leaves of *Cydonia vulgaris, Malus coronaria, Amelanchier erecta,* and also on the fruit of the last. The only infection was on the fruit of the *Amelanchier,* showing numerous pycnia May 12, and aecia in great abundance May 24. Another collection on the same host sent by Professor E. Mead Wilcox from Lincoln, Neb., was sown May 11 on leaves of the same three hosts, with infection only on the *Malus,* giving pycnia June 2, but the leaves dying before aecia formed.[12]

9. GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) DC., on *Juniperus sibirica* Burgsd., was sent by Mr. E. Bethel from Lake Eldora, Colo., and sown May 25 in the open orchard on fruits of pears and apples, and in the greenhouse on leaves of *Cydonia vulgaris* and fruits of *Amelanchier erecta,* with no results except on fruits of *Amelanchier,* giving abundant pycnia May 31, and very abundant aecia June 15.[13]

[11] See Mycol. 4: 24. 1912.

[12] For previous cultures see Jour. Myc. 2: 230. 1910; and 4: 25. 1912.

[13] For previous cultures see Jour. Myc. 14: 18. 1908; Mycol. 1: 239. 1909; and 4: 24. 1912.

10. GYMNOSPORANGIUM INCONSPICUUM Kern, on *Juniperus utahensis* (Engelm.) Lemmon, sent by Mr. E. Bethel from Paonia, Colo., was sown April 7 on leaves of *Amelanchier erecta* and of *A. vulgaris,* with infection only on the latter, showing pycnia April 24, but not maturing aecia.[14]

11. GYMNOSPORANGIUM LIBOCEDRI (P. Henn.) Kern, on *Libocedrus decurrens* Torr., sent by an unknown correspondent, was sown April 17 on *Amelanchier vulgaris, Crataegus tomentosa, C. cerronis,* and *Sorbus aucuparia,* with no infection on the last, but pycnia showing on the other hosts April 25, 26 and 28 respectively, and abundant aecia on the *Amelanchier*, showing May 16.[15]

12. GYMNOSPORANGIUM JUNIPERINUM (L.) Mart., on *Juniperus sibirica* Burgsd., sent by Mr. E. Bethel from Palmer Lake, Colo., was sown April 26 on *Sorbus aucuparia,* without producing infection. It was again sown May 5 on *S. americana,* and produced pycnia May 20 in abundance, but did not develop aecia.

The species has not been cultivated before from American material. The first cultures were made in Europe by Robert Hartig[16] about 1882 at Munich, and the species named *G. tremelloides,* from its conspicuous telia. The Linnaean name appears to have been transferred by Oersted in 1866 to a much less conspicuous form, as pointed out by Kern,[17] but it seems best now to follow the original usage. The galls used in the present culture were on small branches and about one centimeter across.

13. COLEOSPORIUM VERNONIAE B. & C. A collection of *Peridermium carneum* Bosc, on *Pinus taeda* L., collected by Mr. Ray Stretch and the writer at Mississippi City, Miss., was sown March 6 on *Laciniaria scariosa* and *Vernonia gigantea,* with infection only on the latter, uredinia showing March 22. Three other collections on *Pinus taeda* L., made by the same persons at Biloxi, Miss., were each sown March 8 on *Laciniaria scariosa* and *L. punctata,* with no infection. The results confirm the work of 1910.[18]

[14] For previous cultures on fruit of *Amelanchier* see Jour. Myc. 14: 24. 1908.

[15] For previous cultures see Mycol. 1: 252. 1909.

[16] Hartig, Lehrb. Baum-Kr. 133. 1882.

[17] Science 27: 930. 1908; Bull. Torrey Club 35: 499. 1908; and Bull. N. Y. Bot. Gard. 7: 458. 1911.

[18] See Mycol. 4: 29. 1912.

14. MELAMPSORA ALBERTENSIS Arth., on *Populus tremuloides* Michx., from Palmer Lake, Colo., sent by Mr. E. Bethel, was sown April 20 on *Larix laricina, Ribes Cynosbati* and *Pseudotsuga mucronata,* with infection only on the last, showing pycnia in abundance May 4, and aecia May 9.[19] On our excursion to Colorado in September Dr. Kern and the writer in company with Mr. Bethel observed great areas of the mountain sides covered with the yellowed foliage of *P. tremuloides,* almost every leaf of which showed uredinia and telia of this rust. It seems remarkable there should be so few collections of it in herbaria, and also of its aecia on *Pseudotsuga.*

15. MELAMPSORELLA ELATINA (A. & S.) Arth. Part of a large witches' broom of *Aecidium elatinum* A. & S., on *Abies lasiocarpa* Nutt., was sent by Mr. E. Bethel from Lake Eldora, Colo., 9,000 feet altitude, and sown August 8 on *Cerastium oreophilum,* giving an exceedingly abundant infection of uredinia, first recorded on September 7. This is the first culture of the species with American material. In Europe cultures with aeciospores have been made by von Tubeuf,[20] Klebahn,[21] and Ed. Fischer,[22] and indications of races have been found. This is an interesting species of rust from the unusual fact of both phases having perennial mycelium.

SUCCESSFUL CULTURES REPORTED NOW FOR THE FIRST TIME.—The following species have never before been cultivated, in America or elsewhere, so far as the writer knows. It is much to be regretted that some of the species could not be brought to full development, but although the results are in part imperfect, they represent most important additions to previous knowledge.

1. PUCCINIA LYGODESMIAE Ellis & Ev., on wintered-over stems of *Lygodesmia juncea* (Pursh) D. Don, collected April 6, 1911, by Mr. E. Bartholomew, at Stockton, Kans., was sown on plants

[19] For previous cultures see Mycol. 4: 29. 1912.

[20] Deuts. Bot. Ges. 19: 433. 1901; Arb. Biol. Abth. Land.-Forstw. Kais. Gesundh. 2: 368.

[21] Jahr. Wiss. Bot. 35: 699. 1901; Zeits. Pfl.-Kr. 12: 139. 1902; and Jahr. Hamb. Wiss. Anst. 20[3]: 31. 1902.

[22] Ber. Deut. Bot. Ges. 19: 397. 1901; Zeits. Pfl.-Kr. 11: 321. 1901; and 12: 193. 1902.

of the same species April 19, and characteristic telia were observed May 3, without being preceded by pycnia or other spore-forms. The species clearly produces but the one form of spore in its life cycle. The aecia often found on this host are undoubtedly heteroecious.

2. AECIDIUM MONOICUM Peck, on *Arabis* sp. Living plants of some smooth leaved species of *Arabis* bearing aecia were sent by Mr. E. Bethel from Boulder, Colo., 5,000 feet altitude, and arranged May 9 over plants of *Koeleria cristata, Stipa viridula,* and *Trisetum subspicatum,* followed by infection only on the last, uredinia and telia being first observed June 1. Similar plants bearing aecia were also sent by Mr. Bethel from Lake Eldora, Colo., 9,000 feet altitude, and placed over plants of *Koeleria cristata* and *Trisetum majus,* followed by infection on the latter only, uredinia and telia being first observed July 24.

The results of the cultures appear unequivocal. The aecia used belong to a form on *Arabis,* and probably also on related genera, very common throughout the Rocky mountain region, which infests the whole plant and usually prevents it from flowering, consequently the determination of hosts is usually difficult and often impossible. Whether all collections labelled *Aecidium monoicum* Peck belong here may be left to future examination, but most of them doubtless do so, although there may be races going to different species of grasses. A bright yellow form on *Cheiranthus Menziesii* from Nevada was named *Aecidium auriellum* by Mr. Peck, and may be identical with the *Arabis* forms, as the difference in color appears to be incidental.

The telial phase has passed under the name *Puccinia Trisceti* Erikss., a name which belongs to a species with covered telia, that has not with certainty been found in America. The rust with similar naked telia on *Koeleria* and *Stipa, Puccinia Stipae* Arth., is almost identical in morphological characters, but it forms the curious *Aecidium sclerothecioides* E. & E. on composites. There is, moreover, an adaptive distinction—the *Trisetum* form is capable of germination as soon as the teliospores are mature, while in *P. Stipae* the teliospores require a period of rest, and first show their viable character the following spring. Teliospores from the first of the above recorded cultures were tested

in drop culture, and gave abundant and vigorous germination after twelve hours. Sowings were at once made June 29 on two plants of *Arabis* in the rosette stage, grown from seed sent by Mr. Bethel from Colorado. One plant flowered later and showed no evidence of infection. The other plant gradually developed numerous lateral buds, forming a compact mass of small rosettes. This rather abnormal development seems to indicate a probable infection, but the proof must await the elongation of the stems at flowering time next spring.

The credit for detecting the probable connection of these aecial and telial forms is to be shared by Mr. A. O. Garrett and Mr. E. Bethel. On packet 75 of the Fungi Utahensis, *Aecidium monoicum* on *Arabis Drummondii,* Mr. Garrett adds the note, "apparently connected with a rust on *Trisetum subspicatum.*" This collection was made July 22, 1905, and in a letter dated April 30, 1906, he writes: "On July 22 I made a collection of aecidia on *Arabis Drummondii.* The plants were in an open place on the mountain side between spruce timber on either side. On August 21 I returned to the spot to hunt for the alternate form of the *A. monoicum.* Upon reaching the locality I found a plant of *Trisetum subspicatum,* and on it I found teleutospores [distributed in Fungi Utahensis *194*]. Immediately next to it I found a dried up plant of *A. Drummondii* with abundant aecidia. Looking further, I found that wherever I found the III, I found I, although in a few cases I found I without running across III." It should be borne in mind that these observations were made in the arid region of the Rocky mountains, where juxtaposition is more significant than in more humid regions. Mr. Bethel made similar observations at various times in Colorado, and is, moreover, convinced from his field studies that the same species of rust occurs on *Koeleria* and *Stipa.* This may be true, and collections in the herbarium seem to justify the opinion, at least for *Koeleria,* but cultures are yet wanting, material for which should be gathered in late summer or autumn, and not in spring. In a letter dated April 9, 1911, Mr. Bethel makes the significant statement: "The *Koeleria* and *Trisetum* rusts have a strange way of disappearing. It is almost impossible to find them in the spring. I brought home plants of both *Koeleria* and

Trisetum last fall which were very badly rusted, and planted in the garden. However, this spring I can see the telia on only one leaf, and that is the *Trisetum*." Even the rust on the one leaf may have been another species. The evanescent character of this species corresponds to that of *Puccinia Eatoniae* Arth., having aecia on *Ranunculus abortivus* from a diffused mycelium and appearing over the whole surface of the leaf early in spring.

As the rust is now for the first time clearly recognized, it is herewith distinctively named and characterized.

Puccinia monoica (Peck) n. nom. (*Aecidium monoicum* Peck, Bot Gaz. 4: 230. 1879.)

O. Pycnia amphigenous, thickly scattered over large areas, preceding or among the aecia, honey-yellow becoming brownish, sub-epidermal, flattened-globose, 90–160μ in diameter by 60–112μ high; ostiolar filaments 30–90μ long.

I. Aecia chiefly hypophyllous, evenly and thickly scattered, usually occupying the whole under surfaces of the leaves, cupulate or short cylindrical, 0.3–0.4 mm. in diameter; peridium whitish, the margin erect or spreading, somewhat lacerate, the peridial cells rhomboidal, 29–34μ long, the outer wall 7–10μ thick, striate, the inner wall 3–3.5μ thick, verrucose; aeciospores globoid, 15–23 by 18–25μ, the wall colorless, 1.5–2.5μ thick, rather finely verrucose.

II. Uredinia chiefly epiphyllous, somewhat gregarious, oval or oblong, 0.5–1 mm. long, cinnamon-brown, pulverulent; urediniospores broadly ellipsoid or obovoid, 19–21 by 24–31μ, the wall cinnamon-brown, about 2μ thick, finely and closely echinulate, the pores 6–8, scattered.

III. Telia chiefly epiphyllous, more or less gregarious, oval, oblong, or roundish, 0.5–1 mm. long, pulvinate, chocolate-brown or cinereous by germination at maturity, early naked; teliospores ellipsoid or clavate-oblong, 16–24 by 34–45μ, the wall cinnamon-brown, 1–1.5μ thick, thicker at apex, 5–10μ, smooth; pedicel nearly or quite colorless, rather slender, once to twice length of spore.

O and I. Pycnia and aecia on various species of *Arabis* throughout the Rocky mountain region, type collection from Colorado, on *Arabis retrofracta*, made by T. S. Brandegee.

II and III. Uredinia and telia on various species of *Trisetum*, the present known geographical range not so great as for the aecial stage.

3. GYMNOSPORANGIUM NELSONI Arth. (*G. durum* Kern), on *Juniperus utahensis* (Engelm.) Lemmon, sent by Mr. E. Bethel from Delta, Colo., was sown April 5 on *Amelanchier vulgaris*,

A. erecta, Crataegus cerronis, Philadelphus coronarius, and on the last species once more April 12. The only infection was on *Amelanchier vulgaris,* showing pycnia April 24, but failing to mature aecia. Other sowings made in May were without results. The connection with aecia on *Amelanchier* had been predicted by Mr. Bethel from his field observations in Colorado from 1907 to the present season, and also by Mr. A. O. Garrett in Utah, 1910. The same kind of observation is recorded by Tracy & Earle for southern Colorado in 1898.[23] The galls used for these sowings were on small twigs, globoid, and from 1 to 2 cm. in diameter. This form, generally distributed under the name of *G. durum* Kern, has recently been united by Dr. Kern[24] with *G. Nelsoni* Arth. On the type specimens of the latter the galls are small, only 1–8 mm. in diameter, and hence not at first readily identified with the large woody galls, which have been called *G. durum.*

All cultures heretofore reported in this series under the name *G. Nelsoni* belong not to this species but to *G. juvenescens* Kern, as stated in the report for 1910.[25] The latter is a species producing witches' brooms, but not woody galls.

4. GYMNOSPORANGIUM KERNIANUM Bethel, on *Juniperus utahensis* (Engelm.) Lemmon, sent by Mr. Bethel from Paonia, Colo., was sown April 7 on *Amelanchier vulgaris,* and *Crataegus cerronis,* with infection only on the *Amelanchier,* showing pycnia April 17, but not maturing aecia. Another sowing on *Amelanchier vulgaris* April 17 was without result, and the same was true of another collection from Paonia, Colo., sown on the same day. The failure to secure aecia makes it impossible to identify the aecia of this species among the many forms occurring on *Amelanchier,* although it is doubtless already in the hands of collectors. So far as the evidence goes it bears out Mr. Bethel's surmise[26] regarding the aecial hosts. This culture is referred to by Kern[27] in his monograph on the genus *Gymnosporangium.*

5. GYMNOSPORANGIUM EFFUSUM Kern, on *Juniperus virginiana*

[23] Greene, Plantae Bakerianae 1: 19. 1901.

[24] Bull. N. Y. Bot. Gard. 7: 448, 470. 1911.

[25] Mycol. 4: 26. 1912.

[26] See Mycol. 3: 158. 1911.

[27] See Bull. N. Y. Bot. Garden 7: 449. 1911.

L., collected at Newfield, N. J., by Messrs. F. D. Kern and B. O. Dodge, was sown May 4 on *Aronia arbutifolia, Amelanchier canadensis, Pyrus communis, Malus coronaria,* and *M. Malus,* with infection on the first only, showing pycnia in abundance June 15, but failing to develop aecia.

Although this infection did not proceed to a sufficient development to show the identity of the aecia, yet there are some reasons, chiefly relating to host and geographical distribution for thinking that we are dealing with *Roestelia transformans* Ellis, which was described by Mr. Ellis from material collected at Newfield, N. J., on *Aronia arbutifolia.*

6. GYMNOSPORANGIUM GRACILENS (Peck) Kern & Bethel (*G. speciosum* Peck), on *Juniperus monosperma* (Engelm.) Sarg., sent by Mr. Bethel from Trinidad, Colo., was sown April 26 on *Crataegus tomentosa, Sorbus aucuparia,* and *Philadelphus coronarius,* with heavy infection on the last, showing pycnia May 6, and aecia May 29. Before the infection had become certain another sowing was made May 1 on *Amelanchier vulgaris,* and the day following again on another plant of the same host, and also on the fruit of *A. erecta,* as well as the leaves of *Philadelphus coronarius.* Again infection was secured only on the *Philadelphus,* the pycnia showing in the greatest abundance May 13, and aecia June 8.

This connection was suggested by Mr. Bethel, who has given a history of his observations in a recent number of MYCOLOGIA.[28] The result of this set of cultures was communicated to Dr. F. D. Kern, then residing in New York, which enabled him to complete the description and synonymy of the species and to list the aecial hosts in his monograph of the genus *Gymnosporangium.*[29] The connection is especially notable, as it carries the aecial hosts of *Gymnosporangium* outside the families of Malaceae and Rosaceae, into the Hydrangiaceae. As the studies of this genus progress more and more evidence is secured to show that it possesses outlying species approaching in form and habit some of those in other genera.

[28] Bethel, Notes on some species of *Gymnosporangium* in Colorado, Mycol. 3: 156–160. 1911.

[29] See Bull. N. Y. Bot. Garden 7: 458. 1911.

The ease with which infection of the garden *Philadelphus,* originally a native of the Caucasus, was secured proved a surprise. Every effort was made to obtain native species of the genus, but without success until too late for culture work.

SUMMARY

The following is a complete list of the successful cultures made during the year 1911. It is divided into two series, species that have previously been grown in cultures and reported by the writer or other investigators, and species whose culture is now reported for the first time.

A. SPECIES PREVIOUSLY REPORTED

1. *Puccinia Peckii* (DeT.) Kellerm.—Teliospores from *Carex lanuginosa* Michx., sown on *Onagra biennis* (L.) Scop.

2. *Puccinia angustata* Peck.—Teliospores from *Scirpus cyperinus* (L.) Kunth, sown on *Lycopus americanus* Muhl.

3. *Puccinia Phragmitis* (Schum.) Körn.—Teliospores from *Phragmites communis* Trin., sown on *Rumex crispus* L.

4. *Puccinia cinerea* Arth.—Teliospores from *Puccinellia airoides* (Nutt.) Wats. & Coult., sown on *Oxygraphis Cymbalaria* (Pursh) Prantl.

5. *Puccinia subnitens* Diet.—Teliospores from *Distichlis spicata* (L.) Greene, sown on *Cleome spinosa* L., *Atriplex hastata* L., and *Chenopodium album* L.

6. *Uromyces Peckianus* Farl.—Teliospores from *Distichlis spicata* (L.) Greene, sown on *Atriplex hastata* L.

7. *Uromyces Medicaginis* Pass.—Urediniospores from *Medicago sativa* L., sown on same species of host.

8. *Gymnosporangium Nidus-avis* Thax.—Teliospores from *Juniperus virginiana* L., sown on fruits of *Amelanchier erecta* Blanch. and leaves of *Malus coronaria* (L.) Mill.

9. *Gymnosporangium clavariaeforme* (Jacq.) DC.—Teliospores from *Juniperus sibirica* Burgsd., sown on fruits of *Amelanchier erecta* Blanch.

10. *Gymnosporangium inconspicuum* Kern.—Teliospores from *Juniperus utahensis* (Engelm.) Lemmon, sown on leaves of *Amelanchier vulgaris* Moench.

11. *Gymnosporangium Libocedri* (P. Henn.) Kern.—Teliospores from *Libocedrus decurrens* Torr., sown on *Amelanchier vulgaris* Moench, *Crataegus tomentosa* L., and *C. cerronis* A. Nels.

12. *Gymnosporangium juniperinum* (L.) Mart. (*G. tremelloides* R. Hartig).—Teliospores from *Juniperus sibirica* Burgsd., sown on *Sorbus americana* Marsh.

13. *Coleosporium Vernoniae* B. & C.—Aeciospores from *Pinus taeda* L., sown on *Vernonia gigantea* (Walt.) Britton.

14. *Melampsora albertensis* Arth.—Teliospores from *Populus tremuloides* Michx., sown on *Pseudotsuga mucronata* (Raf.) Sudw.

15. *Melampsorella elatina* (A. & S.) Arth.—Aeciospores from *Abies lasiocarpa* Nutt., sown on *Cerastium oreophilum* Greene.

B. SPECIES REPORTED NOW FOR THE FIRST TIME

1. *Puccinia Lygodesmiae* Ellis & Ev.—Teliospores from *Lygodesmia juncea* (Pursh) D. Don, sown on the same species of host.

2. *Puccinia monoica* (Peck) Arth.—Aeciospores from *Arabis* sp., sown on *Trisetum subspicatum* (L.) Beauv., and *T. majus* (Vasey) Rydb.

3. *Gymnosporangium Nelsoni* Arth. (*G. durum* Kern).—Teliospores from *Juniperus utahensis* (Engelm.) Lemmon, sown on *Amelanchier vulgaris* Moench.

4. *Gymnosporangium Kernianum* Bethel.—Teliospores from *Juniperus utahensis* (Engelm.) Lemmon, sown on *Amelanchier vulgaris* Moench.

5. *Gymnosporangium effusum* Kern.—Teliospores from *Juniperus virginiana* L., sown on *Aronia arbutifolia* (L.) Ell.

6. *Gymnosporangium gracilens* (Peck) Kern & Bethel.—Teliospores from *Juniperus monosperma* (Engelm.) Sarg., sown on *Philadelphus coronarius* L.

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A BLACK KNOT DISEASE OF DIANTHERA AMERICANA L.

I. M. Lewis

(With Plates 58–61, Containing 10 Figures)

Introduction

During the past two years the water willow, *Dianthera americana,* growing along a small creek near the campus of the University of Texas has been affected with a disease which does not appear to have been heretofore reported. Affected plants were first observed during the summer of 1910, but owing to the pressure of other duties at that time the investigation was only superficial and failed to reveal the true nature of the trouble. At the beginning of the present season however, it was made a subject of special investigation which has brought out clearly the nature of the disease and all of the salient features in the life history of the causal organism. A few points which as yet are not fully determined will be more carefully followed this coming season.

Symptoms of the Disease

The disease affects the aerial portions of the plant and produces numerous hypertrophied areas of the internodes. These areas are not localized on any particular portion of the stem but occur at irregular intervals beginning near the base and extending to the tip. The internode which bears the inflorescence, and midrib of the leaf are frequently affected. The swollen areas vary in length from one to three centimeters and usually completely encircle the stem. The hypertrophy is not uniform but occurs as distinct ridges opposite the peripheral steles, which in this species of *Dianthera* are six in number (Plate LIX, fig. 1).

As the disease develops the outer tissue of the stem is ruptured by a longitudinal fissure and exposes the developing fungus which presents a smooth grayish surface over a dark background

of compact tissue. In typical cases there are six such ruptures, one for each of the peripheral steles. In older stages the fungus areas become somewhat confluent, but they always remain more or less separate. The surface becomes distinctly roughened and papillate with age. The grayish color disappears and the entire area becomes jet black (Plate LVIII, figs. 1 and 2).

ETIOLOGY AND EFFECT ON THE HOST

In order to facilitate the study of the relationship of fungus and host, sections were prepared from normal portions of the stem and from affected areas in different stages of development. The material was fixed in chrom-acetic acid fixing solution and imbedded in celloidin. Both longitudinal and transverse sections were prepared and then stained with aniline safranin and Delafield's haematoxylin.

A section through one of the affected areas reveals the fact that the fungus bears a close relation to the vascular tissue of the host, and that certain definite structural modifications are caused by it.

The stem is polystelic, there being seven steles, six of which are disposed in a circle in the peripheral portion while one occupies a position near the center of the stem. The ground tissue is made up of thin-walled parenchymatous cells with large intercellular spaces typical of aquatic or semiaquatic plants. The steles are orbicular in cross section and each is surrounded by a thin-walled, completely closed endodermis. Inside the endodermis there is a layer of thin-walled stereomatic tissue. The mestome bundles are collateral and arranged in an arch toward the periphery of the stem, while the inner face of the stele is occupied by a pith and a few scattered strands of pure leptome. The cambium lies inside the leptome.

Sections taken from portions of the stem somewhat removed from one of the affected areas show the same structure as a normal unaffected stem except that the vessels of the xylem contain numerous fungal filaments (Plate LXI, fig. 3; Pl. LX, fig. 1). In some cases the vessels are completely filled with the filaments of the fungus.

All portions of the affected plants reveal the presence of these

filaments in the vascular tissue but they never invade the ground tissue except in the swollen areas noted above. Sections have been taken from the aerial portions, the rhizome, and the roots. At this season of the year (November) underground portions of the plant are abundantly supplied with the fungal filaments while the aerial parts have died down and almost completely disappeared. It seems highly probable that these filaments persist throughout the winter and begin growth with the aerial portions in the spring. Strength is afforded this hypothesis by the fact that the disease occurs in localized areas while plants somewhat removed are often unaffected. This point however has not been definitely determined.

The fungus causes decided structural changes in the steles and in the ground tissue immediately surrounding them. These changes are affected only in portions of the stem which become hypertrophied as noted above. The steles are generally changed in outline and frequently become branched. The cambium of the inner face is stimulated to produce new xylem cells and frequently a wedge-shaped area results which is greater in extent than the original stele. The cells of this enlarged portion always contain filaments of the fungus (Plate LX, fig. 1).

The loose, lace-like ground tissue surrounding the stele is replaced by a dark, compact parenchyma with no intercellular spaces. This tissue seems to be made up of cells of both fungus and host but in some cases the host tissue is changed beyond the border of the fungus invasion. This parenchyma develops from the side of the stele directed toward the periphery of the stem, while there is little or none of it produced toward the center. The central stele is also usually affected (Plate LIX, fig. 1). Compare cells of the normal ground tissue in parts of Plate LIX with Plate LX, fig. 1.

The fungus, after it reaches the outer part of the stem, forms a layer of rather loose pseudoparenchyma which bursts open the epidermis producing the pulvinate effect already noted. From this tissue the conidiophores arise. The conidiophore layer is very compact in structure and its outer surface is quite smooth and even. The conidiophores produce numerous crops of spores. In cross section this layer is marked by several

concentric lines (Plate LIX, fig. 2). These lines serve to indicate the number of crops of spores produced as they are formed by the broken stubs or remnants of branches from which the spores have fallen. Figure 2, Plate LIX, shows an area which has borne six or seven crops of spores. This figure shows also the shape and outline of the conidiophore layer.

The conidiophores are somewhat branched, septate, packed very closely together and bear spores at the tip and from very short lateral outgrowths near the tip. They continue growth in length by a lateral branch after the spores have fallen and the broken stubs appear in cross section as distinct lines. The conidiospores are unicellular, oval, hyaline and measure 10 to 15 by 3μ (Plate LXI, fig. 2).

With age this layer begins to slough away, giving the outer surface a very rough ragged appearance. While the conidiophore layer is breaking down a differentiation takes place in the deeper stromatic mass upon which it rests. In transverse sections small cavities appear in the stroma. These are the beginnings of the perithecia and by the time the outer layer of conidiophores have disappeared they are almost fully developed. The perithecia are numerous and closely packed together in the stroma. They are somewhat elongated 475 to 550 by 300 to 350μ and produce rather long necks which open by a definite ostiole. The broken remains of the conidiophore layer together with the necks of the perithecia cause the ragged papillate character of the surface as noted above.

The asci are small, 50 to 65 by 10 to 15μ, thin-walled, and spring from the bottom and sides of the perithecium. The spores are eight in number, biseriate, unicellular, hyaline, allantoid, and measure 6 to 9 by 2μ. There are no paraphyses (Plate LXI, fig. 4). The perithecia do not develop definite walls but each represents rather a loculus in the stroma (Plate LX, fig. 2).

The cultural characters of the fungus are not at present known, as all attempts to grow it in cultures have failed. Attempts were made to isolate from both the conidiospores and the ascospores as well as the tissue from the stroma but without success.

TECHNICAL DESCRIPTION

There does not appear to be any described genus to which this fungus can be unreservedly referred. The structure of the stroma and of the perithecium places it among the Dothidiaceae. In many respects it resembles *Plowrightia,* and were it not for the fact that the spores are unicellular there would be little objection to assigning it to that genus. However, the spores described above are of undoubted maturity and such a classification is therefore untenable.

It appears to more nearly agree with *Bagniesiella* than any other described genus and probably does not differ from it sufficiently to warrant the founding of a new genus. The shape of the spores is perhaps the most important feature which differs. In *B. australis* the spores are elliptical with obtuse ends and subinequilateral and are therefore not markedly different from the spores herein described.

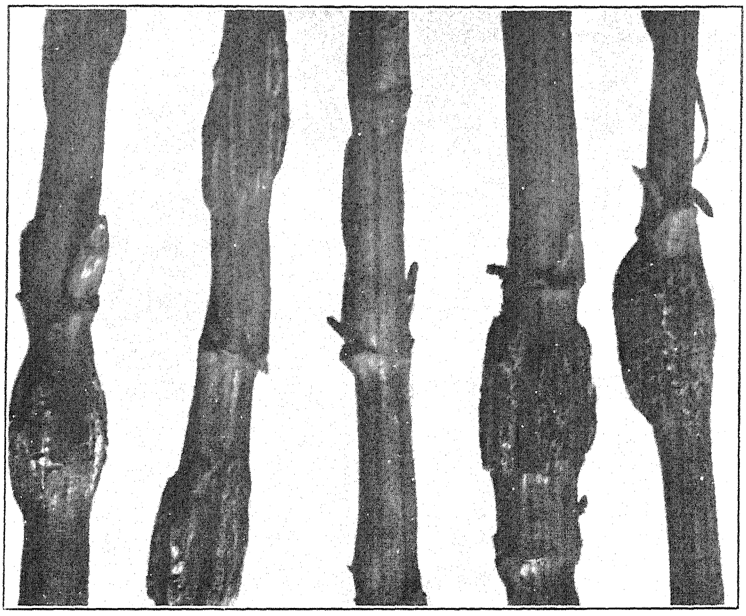
Bagniesiella Diantherae sp. nov.

Stroma erumpent, pulvinate, linear, 10 to 30 mm. in length by 2 to 4 mm. in diameter, black, smooth at first, becoming roughened and tuberculate with age. Conidial stage appearing before the ascigerous and borne on the same stroma. Conidiophores branched, packed closely together, conidiospores hyaline, oval, unicellular, $10–15 \times 3\mu$. Perithecia numerous, subglobose to elongate, immersed in the stroma, $475–550 \times 300–350\mu$. Necks elongate, ostiolate. Asci clavate, $50–65\mu \times 10–15\mu$, without paraphyses, 8-spored. Ascospores biseriate, hyaline, continuous allantoid, $6–9 \times 2\mu$.

On living stems of *Dianthera americana* at Austin, Texas.

In conclusion, the writer wishes to acknowledge his indebtedness to Mrs. Flora W. Patterson for her opinion as to the relationship of the fungus.

UNIVERSITY OF TEXAS,
AUSTIN, TEXAS.



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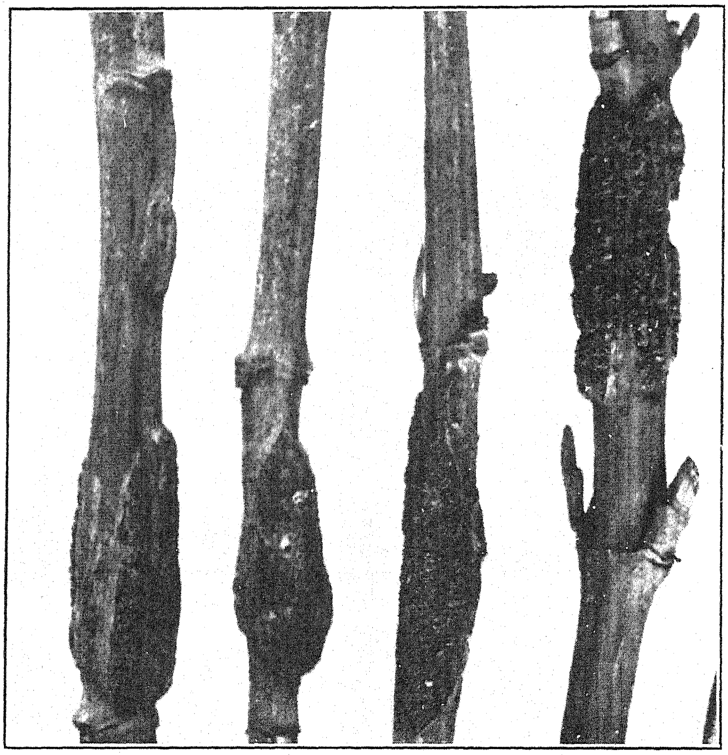

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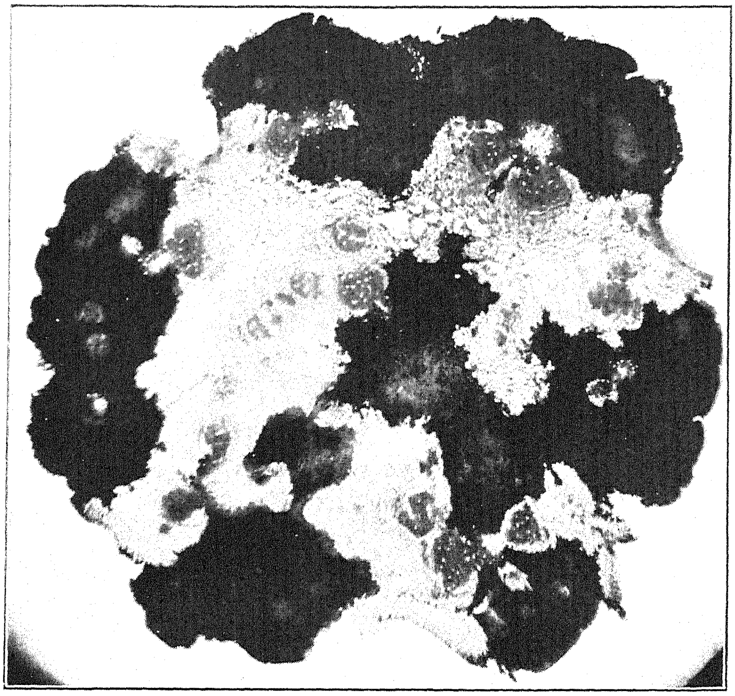
BAGNIESIELLA DIANTHERAE LEWIS



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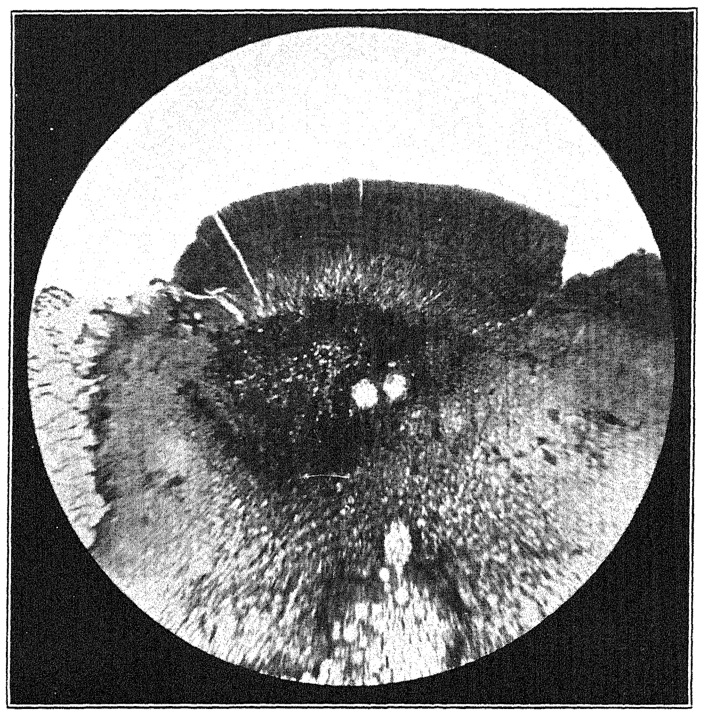

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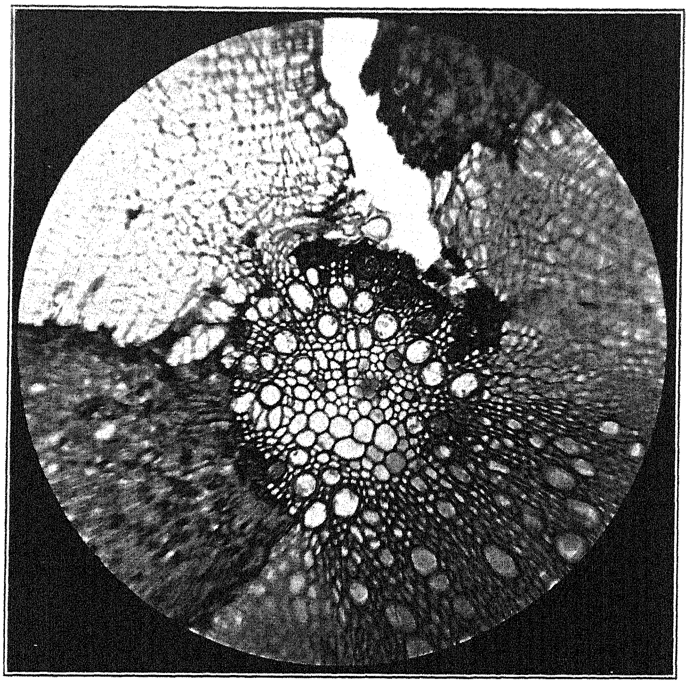

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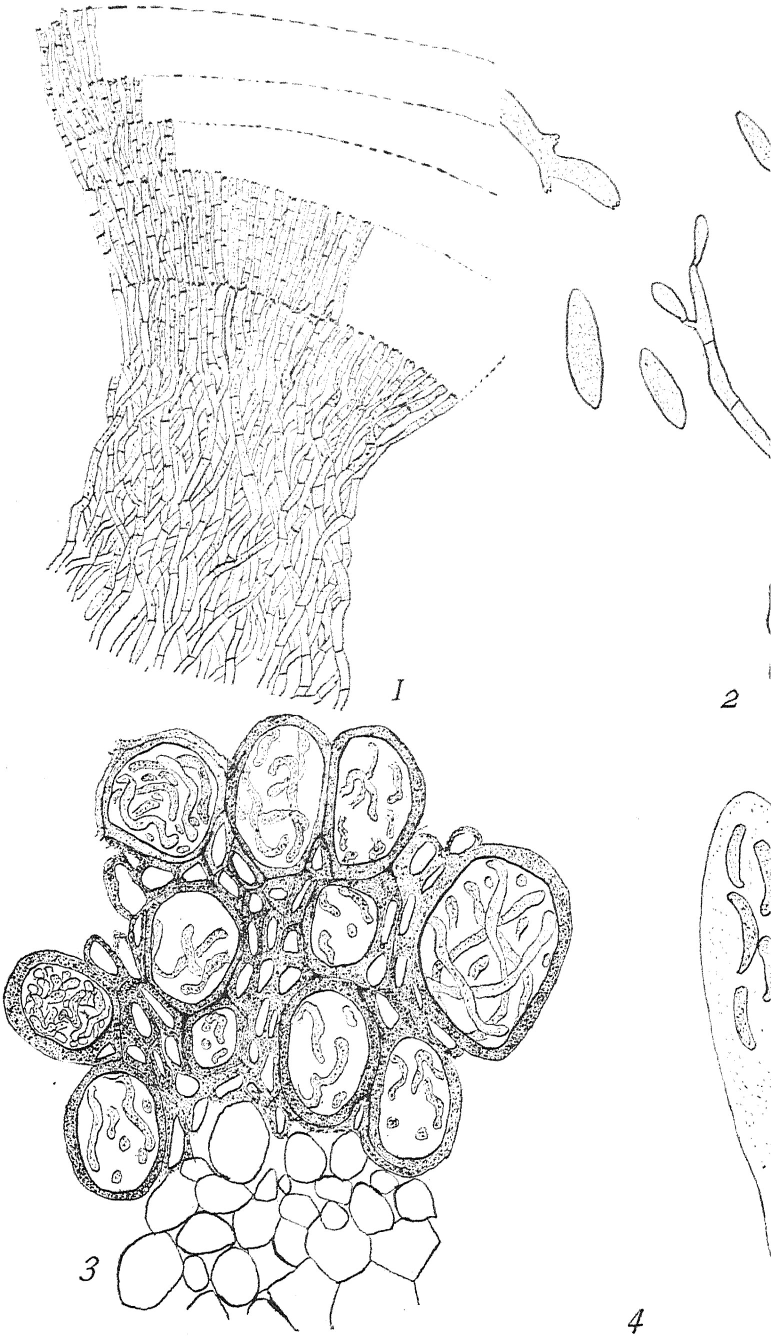

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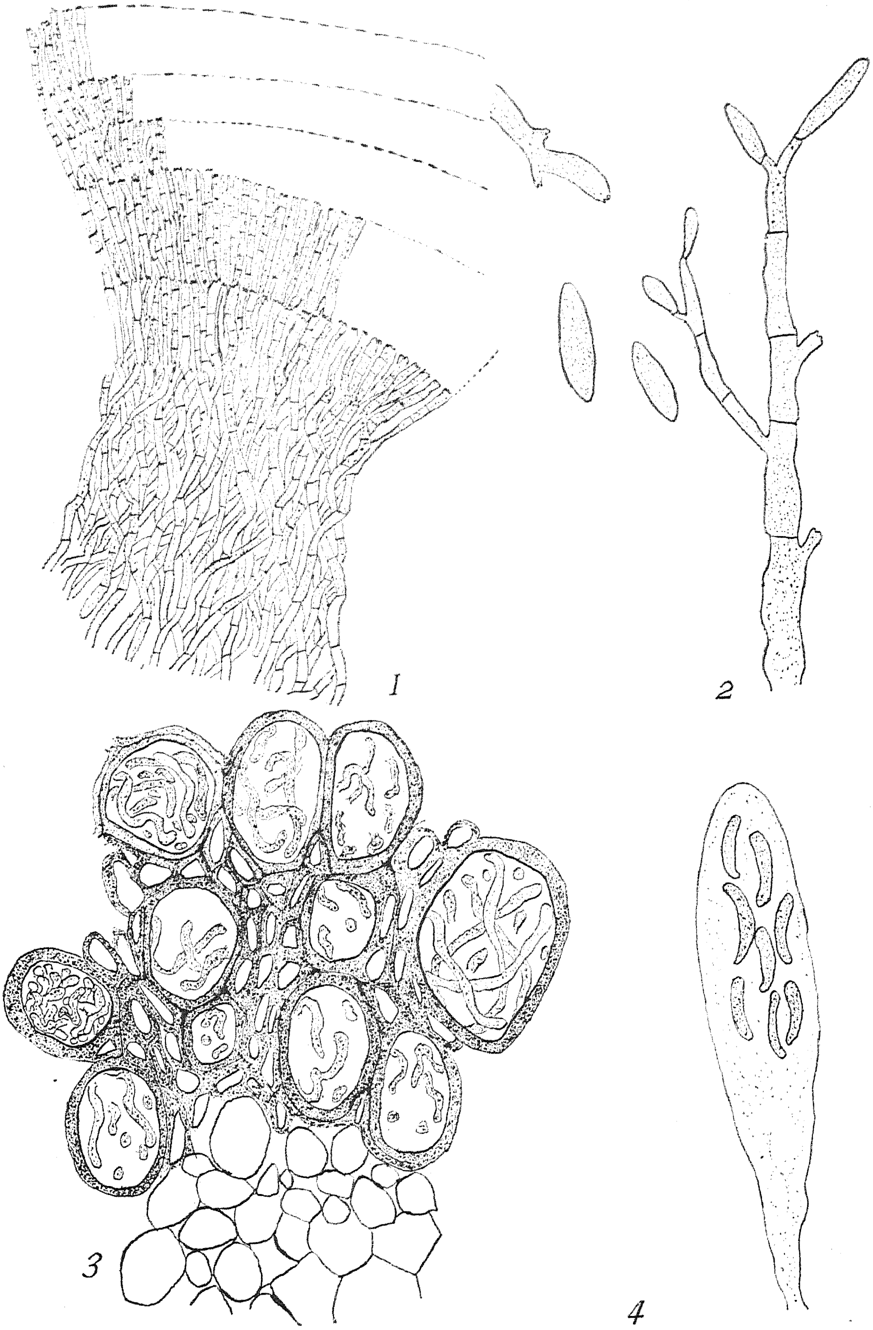


BAGNIESIELLA DIANTHERAE LEWIS

EXPLANATION OF PLATES LVIII–LXI

Plate LVIII, figure 1. Portion of aerial stem of the plant showing hypertrophy opposite the steles and the longitudinal rupture of the host tissue. Both young and older stages are here shown.

Plate LVIII, figure 2. Older stages than shown in figure 1. The fungus areas have become somewhat roughened and tuberculate on the surface.

Plate LIX, figure 1. Transverse section through an affected area. The six peripheral steles and the central one show the effects of the fungus. The ground tissue is normal in portions of the section and shows the changed structure in others. The conidiophore layer may be distinguished around the periphery of the stromata. The clear spaces in the stromata are young perithecia.

Plate LIX, figure 2. A portion of the conidiophore layer more highly magnified. The conidiophores show the concentric zonation which indicates the number of crops of spores they have produced. The dark-colored parenchyma formed by the fungus and host is also shown.

Plate LX, figure 1. One of the peripheral steles showing the formation of additional xylem, the fungal filaments in the vessels, and the changed parenchyma surrounding the steles.

Plate LX, figure 2. Portion of the stroma showing the perithecia and broken ragged nature of the surface of the stroma. The perithecia are immersed locules in the stroma.

Plate LXI, figure 1. Portion of the conidiophore layer showing the uniform zonation. × 300.

Figure 2. Conidiophore and conidiospores. × 800.

Figure 3. Portion of one of the steles showing the location of the fungal tissue within the vessels. × 380.

Figure 4. An ascus with the mature spores. × 1,200.

THE AGARICACEAE OF TROPICAL NORTH AMERICA—V

William A. Murrill

The tropical species with ochraceous or ferruginous spores are treated in this article and the next following in the series. A majority of these species occur on decaying wood. The generic distinctions are not always clearly defined, the group being considered difficult for a beginner.

Lamellae readily separable from the context; pileus dimidiate or resupinate.	1. Tapinia.
Lamellae not readily separable from the contex.	
Volva and annulus absent; veil present at times in young stages, but evanescent.	
Pileus centrally stipitate.	
Stipe cartilaginous.	
Lamellae dissolving at maturity.	2. Mycena.
Lamellae not dissolving at maturity.	
Lamellae free.	3. Pluteolus.
Lamellae adnate or adnexed.	
Margin of pileus straight, from the first.	4. Conocybe.
Margin of pileus at first inflexed.	5. Naucoria.
Stipe fleshy.	
Universal veil arachnoid, distinct from the cuticle; lamellae adnate.	6. Cortinarius.
Universal veil not arachnoid.	
Lamellae sinuate or adnexed.	
Pileus fibrillose or silky.	7. Inocybe.
Pileus smooth and viscid.	8. Hebeloma.
Lamellae adnate or decurrent.	9. Ryssospora.
Pileus dimidiate or resupinate.	10. Phialocybe.
Volva absent, annulus present.	
Pileus hygrophanous.	11. Pholiotina.
Pileus dry.	
Stipe glabrous or fibrillose.	12. Pholiota.
Stipe squarrose-scaly.	13. Hypodendrum.

1. Tapinia (Fries) Karst. Hattsv. 452. 1879

This genus includes the dimidiate or resupinate species of the old genus *Paxillus,* in which the lamellae are usually readily separable from the pileus and anastomose with each other.

Tapinia lignea (Berk. & Curt.)

Paxillus ligneus Berk. & Curt. Jour. Linn. Soc. 9: 423. 1867.

Collected at Orizaba, Mexico, by Botteri, and said by the authors to be allied to *Paxillus panuoides.* The types at Kew much resemble this latter species, and further investigation may show that they do not merit specific distinction.

2. MYCENA (Pers.) Roussel, Fl. Calvados ed. 2. 64. 1806
Bolbitius Fries, Epicr. Myc. 253. 1838.

This genus is characterized among the ocher-spored genera by its deliquescent lamellae. There are few species in it, and these are not generally well known.

1. **Mycena fragilis** (Fries)

Bolbitius fragilis Fries, Epicr. Myc. 254. 1838.

Reported from the Antilles by Fries, and from two collections by Duss in Guadeloupe.

2. **Mycena villipes** (Fries)

Bolbitius villipes Fries, Nova Acta Soc. Sci. Upsal. III. 1: 28. 1851.

Collected and well figured in color by Oersted at Naranjo, Costa Rica. No specimens of it were found in Europe.

3. **Mycena jalapensis** sp. nov.

Pileus conic to expanded, thin, umbonate, gregarious, 2–4 cm. broad; surface viscid, striate, flavo-melleous, fulvous on the umbo; lamellae free, narrow, close, becoming ferruginous, at length deliquescent; spores ellipsoid or ovoid, smooth, flavo-luteous under a microscope, $12–14 \times 6–8\mu$; stipe cylindric, equal, hollow, glabrous, white or sulfureous, 6–8 cm. long, 2 mm. thick.

Type collected among chips in woods near Jalapa, Mexico, 5,000 ft. elevation, December 12–20, 1909, *W. A. & Edna L. Murrill 102 (type), 128.*

4. **Mycena mexicana** sp. nov.

Pileus subcespitose, conic to expanded, umbonate, about 2 cm. broad; surface striate, avellaneous, fuliginous on the umbo, subglabrous, dry; lamellae adnexed, rather broad, becoming ferru-

ginous and at length slightly deliquescent; spores ovoid, smooth, ochroleucous under a microscope, usually uninucleate, 8–9 × 4.5–5μ; stipe slender, white, glabrous, cylindric, equal, hollow, 3–4 cm. long, 1 mm. thick.

Type collected on decayed wood in coffee plantations at Xuchiles, near Cordoba, Mexico, January 17, 1910, *W. A. & Edna L. Murrill 1127.*

3. PLUTEOLUS (Fries) Gillet, Champ. Fr. 1: 549. 1876

This genus has free lamellae and neither volva nor veil. Few species are known.

Pluteolus tropicalis sp. nov.

Pileus thin, delicate, expanded, 3–5 cm. broad; surface pale-isabelline or ochraceous, glabrous, striate to the disk; context very thin, brownish, mild, with a strong odor of jessamine; lamellae free, crowded, narrow, ochraceous or isabelline to dull-cinnamon; spores ellipsoid, smooth, slightly truncate at one end, with one or more nuclei, ferruginous, 12–14 × 7μ; stipe cylindric, slightly tapering upward, pruinose-floccose, whitish, with flesh tints below, hollow, fragile, 7–10 cm. long, 3–4 mm. thick.

Type collected on rotting grass in a plowed field at Herradura, Cuba, August 28, 1906, *F. S. Earle 536.* Also collected in a banana field at Santiago de las Vegas, Cuba, June 18, 1904, *F. S. Earle 102;* in grassy ground at Rincon, Cuba, September 8, 1904, *F. S. Earle 165;* and several times on the ground and once in a bamboo stump at St. George's, Grenada, July and August, 1905, *W. E. Broadway.*

4. CONOCYBE Fayod, Ann. Sci. Nat. VII. 9: 357. 1889

Galera (Fries) Quél. Champ. Jura Vosg. 103. 1872. Not *Galera* Blume. 1825.

This genus differs from *Naucoria* in having the margin straight and appressed to the stipe, instead of incurved, in young stages.

1. CONOCYBE TENER (Schaeff.) Fayod, Ann. Sci. Nat. VII. 9: 357. 1889

Galera tener (Schaeff.) Quél. Champ. Jura Vosg. 104. 1872.
Galera simulans Earle, Inform. An. Estaç. Centr. Agron. Cuba 1: 236. 1906. (Type from Cuba.)

Galera grisea Earle, Inform. An. Estaç. Centr. Agron. Cuba 1: 237. 1906. (Type from Cuba.)

Galera cubensis Earle, Inform. An Estaç. Centr. Agron. Cuba 1: 237. 1906.

This dainty little fungus occurs abundantly on lawns and in manured pastures in temperate regions, and has recently been found to be common about Santiago de las Vegas, Cuba.

Jalapa, Mexico, *W. A. & Edna L. Murrill 139;* Hope Gardens, Jamaica, *Earle 338;* Port Antonio, Jamaica, *W. A. & Edna L. Murrill 223, 245;* Cuba, *Earle 42, 43, 53, 54, 99, 100, 101, 129, 164, 359, 360, 372, 374, Underwood & Earle 1122;* British Honduras, *M. E. Peck;* Grenada, *Broadway.*

2. **Conocybe Hypnorum** (Batsch)

Galera Hypnorum (Batsch) Quél. Champ. Jura Vosg. 105. 1872.

This tiny species is of wide distribution in temperate regions, occurring among mosses or grasses in shaded localities. The cap is conic, striate, variable in color, usually some shade of yellowish-brown. The spores of the Mexican plants are smaller than in typical temperate specimens, and the pileus is pale-isabelline.

Jalapa, Mexico, among mosses in a pasture at the edge of a forest, *W. A. & Edna L. Murrill 109.*

3. **Conocybe echinospora** sp. nov.

Pileus conic to campanulate or convex, umbonate, solitary, 5 mm. broad and high; surface glabrous, dry, striate, fulvous-isabelline, isabelline on the umbo, margin straight, appressed, entire; lamellae broad, distant, fulvous-isabelline; spores broadly ovoid, pointed at one end, minutely echinulate, ferruginous, $7-8 \times 4-5\mu$; stipe glabrous, smooth, slightly tapering upward, very pale latericeous, 1–1.5 cm. long, less than 1 mm. thick.

Type collected on a clay bank at Cinchona, Jamaica, 5,000 ft. elevation, December 25–January 8, 1908–9, *W. A. & Edna L. Murrill 474.*

5. NAUCORIA (Fries) Quél. Champ. Jura Vosg. 99. 1872

In this genus the lamellae are adnexed or adnate, the stipe cartilaginous, and the margin inrolled when young, usually lack-

ing a veil. The spores vary in color from ochraceous to fulvous. Temperate species are numerous and difficult; several have also been described from the tropics.

1. NAUCORIA EUTHUGRAMMUS (Berk. & Curt.) Sacc. Syll. Fung. 5: 835. 1887

Agaricus (Naucoria) euthugrammus Berk. & Curt. Jour. Linn. Soc. **10**: 290. 1868.

Described from Wright's collections on rotten wood in Cuba. Very thin, less than 1 cm. broad, pallid-umbrinous, convex, striate, with filiform, hyaline stipe and minute spores.

2. NAUCORIA OINODES (Berk. & Curt.) Sacc. Syll. Fung. **5**: 842. 1887

Agaricus (Naucoria) oinodes Berk. & Curt. Jour. Linn. Soc. **10**: 291. 1868.

Described from specimens collected by Wright on rotten wood in Cuba. Less than 1 cm. broad, umbonate-hemispheric, vinous, glabrous, striate, with short, fuscous stipe.

3. NAUCORIA PECTINATA (Berk. & Curt.) Sacc. Syll. Fung. **5**: 856. 1887

Agaricus (Naucoria) pectinatus Berk. & Curt. Jour. Linn. Soc. **10**: 291. 1868.

Cespitose on logs, glabrous, striate, 2.5 cm. broad. Types at Kew and Paris are well preserved.

Cuba, *Wright 81;* Mooretown, Jamaica, *Earle 561.*

4. NAUCORIA SEMIORBICULARIS (Bull.) Quél. Champ. Jura Vosg. 100. 1872

Agaricus semiorbicularis Bull. Champ. Fr. *pl. 422. f. 1.* 1788.
Agaricus (Psilocybe) pediades Fries, Syst. Myc. **1**: 290. 1821.
Naucoria pediades Quél. Champ. Jura Vosg. 100. 1872.

This species appears to be common throughout both temperate and tropical regions, appearing abundantly along roads and paths and in grassy places during periods of wet weather. Like most cosmopolitan species, it shows considerable variation, even in spore characters.

Costa Rica, *Oersted;* Santa Cruz, *Oersted;* Guadeloupe, *Duss;* Cuba, *Wright, Earle 540;* Mexico, *Maury, W. A. & Edna L. Murrill 93;* Castleton Gardens, Jamaica, *Earle 233.*

5. **Naucoria corticola** sp. nov.

Pileus thin, convex to subexpanded, gregarious, 1–1.5 cm. broad; surface avellaneous-isabelline, innate-fibrillose with slight tufts, resembling that of *Panus stypticus,* margin undulate, incurved when young; lamellae adnate, dull-whitish to bay-fulvous, broad, heterophyllous, rather distant; spores ellipsoid, smooth, ferruginous, $8–9 \times 4–5\mu$; stipe cylindric, equal, yellow, glabrous at the apex, whitish-pubescent below, 1 cm. long, 1 mm. thick.

Type collected on the bark of a dead stump at Cinchona, Jamaica, 5,000 ft. elevation, December 25–January 8, 1908–09, *W. A. & Edna L. Murrill 533.*

6. **Naucoria cyathicola** sp. nov.

Pileus hemispheric-umbonate to convex, 7–12 mm. broad; surface isabelline, pale-fulvous on the umbo, innate-fibrillose, margin entire, not striate; lamellae distant, squarely adnate, whitish to pale-ochraceous; spores oblong-ellipsoid, smooth, very pale yellowish under the microscope, $6 \times 3.5\mu$; stipe subequal, cylindric, fibrillose, isabelline, cartilaginous, 2 cm. long, 1.5 mm. thick; veil not evident, except in fibrils on stipe and pileus.

Type collected on dead trunks of tree-ferns at Morce's Gap, Jamaica, 5,000 ft. elevation, January 2, 1909, *W. A. & Edna L. Murrill 699.*

7. **Naucoria Earlei** sp. nov.

Pileus thin, convex to expanded or depressed, 2–3 cm. broad; surface glabrous, pallid or alutaceous, margin even or slightly striate; lamellae slightly adnexed, subdistant, rather narrow but ventricose, pallid to fuscous; spores ellipsoid, smooth, fuscous, $10–12 \times 6–8\mu$; stipe cylindric, solid, firm, glabrous, pallid to brownish, darker than the pileus, 3–4 cm. long, 2 mm. thick.

Type collected on damp, bare ground, Castleton Gardens, Jamaica, October 28, 1902, *F. S. Earle 230.*

8. **Naucoria jalapensis** sp. nov.

Pileus thin, conic to convex, umbonate, 2.5 cm. broad; surface pearly-white, slightly yellowish on the umbo, glabrous, dry, stri-

ate, margin at first inflexed; lamellae sinuate-adnexed, broad, rather distant, plane, white to ferruginous, with a purplish tint; spores ovoid or ellipsoid, drawn to a point at one side of the base, smooth, pale-yellow under the microscope, $7 \times 4\mu$; stipe equal, cylindric, curved, milky-white, glabrous, 5 cm. long, 2 mm. thick; veil fibrillose, clinging to the young margin, soon evanescent.

Type collected on dead wood in a moist virgin forest at Jalapa, Mexico, 5,000 ft. elevation, December 12–20, 1909, *W. A. & Edna L. Murrill 161*.

9. **Naucoria hepaticicola** sp. nov.

Pileus hemispheric to convex, gregarious, 1 cm. broad; surface dry, glabrous, smooth, not striate, fulvous; lamellae adnate, plane or slightly arcuate, broad, distant, inserted, melleous to fulvous; spores ovoid, somewhat irregular in outline, pointed at one end, smooth, uninucleate, melleous, $7\text{–}9 \times 4\text{–}5\mu$; stipe curved, tapering upward, glabrous, smooth, cartilaginous, 1.5 cm. long, 2 mm. thick above; veil very slight, fibrillose, evanescent.

Type collected on and among liverworts on a clay bank near Jalapa, Mexico, 5,000 ft. elevation, December 12–20, 1909, *W. A. & Edna L. Murrill 131*.

10. **Naucoria montana** sp. nov.

Pileus hemispheric-umbonate, gregarious, 1–2 cm. broad; surface glabrous, striate, light-brown, dark-brown on the umbo; lamellae adnate, broad, of medium distance, heterophyllous; spores pip-shaped, pointed at one or both ends, minutely echinulate, ferruginous, $9\text{–}11 \times 4\text{–}5\mu$; stipe crooked, slender, cylindric, equal, glabrous, brown above, fuliginous below, 3–4 cm. long, 1–2 mm. thick.

Type collected on dead wood at Cinchona, Jamaica, 5,000 ft. elevation, December 25–January 8, 1908–09, *W. A. & Edna L. Murrill 621*. Also collected on dead wood at Morce's Gap, Jamaica, December 29, 1908, *W. A. & Edna L. Murrill 675*, and on Sir John Peak, Jamaica, 6,000 ft. elevation, January 5, 1909, *W. A. Murrill 819*.

11. **Naucoria pellucida** sp. nov.

Pileus thin, conic to plane, umbonate, 7 mm. broad; surface bay to latericeous on the umbo, testaceous and striate between the

umbo and the margin, dotted over the surface with translucent, gelatinous, pearly-white droplets or specks; lamellae adnexed, ventricose, distant, pale-testaceous, marked with droplets like those on the surface of the pileus; spores ellipsoid, finely echinulate, fulvous, 8 × 5μ; stipe cylindric, equal, smooth, pallid above, bay below, guttate, 1 cm. long, 0.5 mm. thick.

Type collected on dead wood at New Haven Gap, Jamaica, 5,600 ft. elevation, January 4, 1909, *W. A. & Edna L. Murrill 763*. Whether the dots that cover the surface of this tiny species are the remains of a universal veil as in *Tubaria pellucida* or are droplets exuded from the plant under conditions of a maximum amount of moisture, it is impossible at this time to say.

12. **Naucoria Sacchari** sp. nov.

Pileus thin, subfleshy, convex to expanded, obtuse, 1–1.5 cm. broad; surface moist, subviscid, not striate, slightly floccose-scaly to glabrous, pale-fuscous, shading to nearly white on the margin; lamellae adnate, distant, nearly plane, rather broad, pale-fuscous; spores smooth, ellipsoid, ferruginous, 10–12 × 7–8μ; stipe cylindric, hollow, floccose, concolorous, 3–4 cm. long, 1 mm. thick.

Type collected on rotting sugar-cane trash at Hope Gardens, Jamaica, October 31, 1902, *F. S. Earle 322*. The description is drawn from the very complete notes made by Professor Earle from the fresh specimens.

13. **Naucoria spinulifer** sp. nov.

Pileus hemispheric-umbonate with revolute margin, 2 cm. broad; surface innate-fibrillose, smooth, isabelline, testaceous on the umbo, cremeous at the margin; lamellae adnate, arcuate, of medium breadth and distance, dull purplish-isabelline; spores ellipsoid, smooth, ferruginous, 5–7 × 3.5–4μ; cystidia hyaline, flask-shaped with short slender stalk and long cylindric neck, 10–15μ thick, 30–50μ long, including the stalk; stipe curved, cylindric, equal, subglabrous, stramineous above, fulvous below, 2.5 cm. long, 2.5 mm. thick.

Type collected on dead wood at Morce's Gap, Jamaica, 5,000 ft. elevation, December 30, 1908, *W. A. & Edna L. Murrill 705*.

14. **Naucoria tepeitensis** sp. nov.

Pileus very thin, convex, gregarious, reaching 12 mm. broad; surface smooth, whitish, hygrophanous, faintly striate over the

lamellae, margin entire, inrolled when young; lamellae free to adnate, whitish, dull, several times inserted, broad, distant, the edges white and slightly crenulate; spores subovoid, slightly flattened on one side, smooth, uninucleate, very pale melleous under the microscope, $6 \times 4\mu$; stipe crooked, arising from a mat of white mycelium, slightly enlarged above, smooth, glabrous, whitish, hygrophanous, 1 cm. long, about 1 mm. thick.

Type collected on a rotten log in a moist virgin forest in the Tepeite Valley, near Cuernavaca, Mexico, 7,000 ft. elevation, December 28, 1909, *W. A. & Edna L. Murrill 485*.

15. **Naucoria Underwoodii** sp. nov.

Pileus thin, rather fleshy, convex to expanded, scattered, 2 cm. broad; surface glabrous, hygrophanous, brownish, ochraceous when dry, the disk darker; lamellae adnexed, subcrowded, rather broad, subventricose, dull-fulvous; spores broadly ellipsoid, smooth, $8–9 \times 6–7\mu$; stipe crooked, slightly larger below, concolorous, hollow, subfibrillose, the apex floccose-fibrillose, 3 cm. long, 3 mm. thick.

Type collected on rotten wood on El Yunque, Cuba, 1,800 ft. elevation, March, 1903, *Underwood & Earle 1237*.

16. **Naucoria xuchilensis** sp. nov.

Pileus convex to plane, slightly depressed, solitary, 3.5 cm. broad; surface ochraceous, slightly fulvous at the center, subglabrous, even; lamellae adnate, broad, distant, inserted, fulvous; spores ovoid, smooth, uninucleate, ochroleucous, $7–9 \times 4–5\mu$; stipe cylindric, equal, glabrous, cremeous, 2 cm. long, 3 mm. thick.

Type collected in rich, low ground under coffee trees at Xuchiles, near Cordoba, Mexico, 1,500 ft. elevation, January 17, 1910, *W. A. & Edna L. Murrill 1124*.

DOUBTFUL SPECIES

Agaricus (*Naucoria*) *papularis* Fries, Nova Acta Soc. Sci. Upsal. III. **1**: 225. 1851. Collected by Krebs in the island of St. Thomas. Types not found.

Naucoria sideroides (Bull.) Quél. Champ. Jura Vosg. 99. 1872. Reported by Berkeley from Wright's Cuban collections, but evidently a wrong determination.

Agaricus (*Naucoria*) *arenicola* Berk. (Fungi Zeyh. no. 6). Reported by Fries from Oersted's collections in Costa Rica, but very probably different from the South African species. Oersted's figures are unsatisfactory and no specimens are to be found.

Agaricus (*Naucoria*) *cerodes* Fries, Epicr. Myc. 195. 1838. Reported from Santo Domingo, but probably another case of incorrect determination.

Agaricus (*Naucoria*) *coprinoceps* Berk. & Curt. Jour. Linn. Soc. **10**: 290. 1868. Collected by Wright in Cuba. Spores too dark for *Naucoria;* probably a *Psathyra,* one of the brown-spored genera.

6. CORTINARIUS (Pers.) Roussel, Fl. Calvados ed. 2. 61. 1806

This very large and difficult temperate genus has been divided comparatively recently along the subgeneric lines laid down by Fries, but for our present purpose, where only one or two species are concerned, it seems best to retain the old name and to omit synonyms.

Cortinarius mexicanus sp. nov.

Pileus convex, solitary, 4 cm. broad; surface pallid with a lilac tint, ferruginous in places, slightly viscid when moist, margin even; lamellae slightly arcuate, adnexed or rarely free, close, regular, deep-lilac; spores boat-shaped, slightly one-sided at one end, regular, minutely echinulate, ferruginous, $11–12 \times 4–5\mu$; stipe shining-white with a lilac tint, this tint deepening above, cylindric, abruptly bulbous at the base, 5 cm. long, about 6 mm. thick; veil fibrillose, evanescent, soon ferruginous from the spores.

Type collected on humus in a moist virgin forest at Jalapa, Mexico, December 12–20, 1909, *W. A. & Edna L. Murrill 197*.

DOUBTFUL SPECIES

Cortinarius Sintenisii P. Henn. Engl. Jahrb. **17**: 498. 1893. Collected by P. Sintenis on trunks in Porto Rico, and said by the author to be allied to *C. cinnamomeus*. The type specimens have not been examined.

7. INOCYBE (Fries) Quél. Champ. Jura Vosg. 151. 1872

A very large and difficult temperate genus having sinuate or adnexed lamellae and a silky or fibrillose pileus.

Inocybe jamaicensis sp. nov.

Pileus convex with a prominent umbo, especially when young, gregarious, 2–3 cm. broad, 1.5 cm. thick; surface fulvous, minutely imbricate-fibrillose-scaly, margin fading to isabelline with age; lamellae adnate, dirty-white, distant, heterophyllous; spores irregular, angular or nodulose, nearly hyaline under the microscope, copious, $8–9 \times 5\mu$; cystidia turbinate, pointed at each end, $25 \times 17\mu$; stipe equal or slightly larger above, cylindric, avellaneous to brownish below, nearly white above, 3–4 cm. long, 3–5 mm. thick.

Type collected in a clay road at Cinchona, Jamaica, December 25–January 8, 1908–09, *W. A. & Edna L. Murrill 595*.

8. HEBELOMA (Fries) Quél. Champ. Jura Vosg. 334. 1872

This genus has a smooth and usually somewhat viscid cap, sinuate or adnexed lamellae, a fleshy stipe, and a slight, evanescent veil. It is well represented in temperate regions.

1. **Hebeloma Broadwayi** sp. nov.

Pileus fleshy, convex to expanded, 2–4 cm. broad; surface white, glabrous, subviscid, not striate; lamellae adnexed, crowded, rather narrow, white to ochraceous-fulvous, the edge white, crenulate; spores ochraceous-fulvous, ellipsoid, $12–14 \times 7–8\mu$; stipe cylindric, white, glabrous, hollow, 3–4 cm. long, 2–4 mm. thick.

Type collected along roadsides in lowlands at St. George's, Grenada, *W. E. Broadway*.

2. **Hebeloma cinchonense** sp. nov.

Pileus convex to expanded, umbonate, gregarious, 3–6 cm. broad, 1–2 cm. thick; surface pale-isabelline, rarely milky-white with a stramineous tinge, viscid, smooth, margin white, thin, straight, slightly cottony; context white, without characteristic taste; lamellae white, sinuate-adnexed, ventricose, broad; spores pip-shaped, smooth, with a single large, clear nucleus, pale-melleous under the microscope, $8 \times 4\mu$; stipe fleshy with a thin rind,

enlarged below, abruptly bulbous at the base, glabrous, white or pale-yellowish, 3–6 cm. long, 7–10 mm. thick; veil slight, fibrillose, evanescent.

Type collected on the ground in a trail at Cinchona, Jamaica, December 25–January 8, 1908–09, *W. A. & Edna L. Murrill 568.* Also collected in a clay road at Cinchona, Jamaica, *W. A. & Edna L. Murrill 501,* and at New Haven Gap near Cinchona, Jamaica, *W. A. & Edna L. Murrill 772.* This species was apparently abundant about Cinchona at the time of my visit, but it was impossible to obtain many specimens on account of the mongoose, which ate them very greedily.

3. **Hebeloma subincarnatum** sp. nov.

Pileus conic to plane, gregarious, 2–2.5 cm. broad, 7 mm. thick; surface smooth, glabrous, incarnate-isabelline, margin straight; lamellae adnexed, nearly free, cremeous when young, soon becoming luteous, broad, ventricose; spores subellipsoid, one-sided, smooth, with one or two nuclei, very pale yellowish, $8 \times 4\mu$; stipe crooked, cylindric, equal, smooth, ochraceous, fibrillose when young, especially at the top, 3 cm. long, 2.5 cm. thick.

Type collected among moss growing on clay soil in the trail from Monkey Hill to Sir John Peak, 6,000 ft. elevation, January 5, 1909, *W. A. Murrill 795.*

DOUBTFUL SPECIES

Hebeloma longicaudum (Pers.) Quél. Champ. Jura Vosg. **2**: 334. 1874. Certain plants collected by Maury in Mexico have been identified as this species.

NEW YORK BOTANICAL GARDEN.

NOTES ON IOWA SAPROPHYTES—I

GEASTER MINIMUS SCHW. AND ITS RELATIVES

T. H. MACBRIDE

(WITH PLATE 62, CONTAINING 3 FIGURES)

Geaster minimus Schw. is a beautiful little species found at times in considerable numbers growing amid the grass in places where this by reason of lighter soil is not too dense. It has been reported from various parts of the world but so far, in North America, from the eastern, forested region of the continent only. The type would appear to have been taken in South Carolina, perhaps about 1821, where it was found later also by Ravenel. It occurs, as reported, in South America, in Ceylon, Australia, Borneo, but, curiously, not in Europe.

However, in 1842, Vittadini described from northern Italy a little geaster, *G. marginatus,* which according to Saccardo is related to the Schweinitzian type and "appears to differ in the form of endoperidium only and in the '*rima*' around the peristome." This "*rima*" is, properly speaking, a fissure, slit, or other elongated opening. Morgan (Jour. Cin. Soc., 1899) translates *rima* "chink" and says it appears sometimes in specimens recognized by him as *G. minimus* Schw. A chink in the sense of an opening or a fissure would seem here a morphological impossibility. Such a chink would cut out the peristomic areole.

Schweinitz describes *Geaster minimus* (Syn. Fung. Carol., No. 327): Peridium ovate, at the base plane, white, subpedicellate: the mouth plano-conic, ciliate; the volva (the outer peridium) multifid, fuscescent, white below. Everywhere, on the bare ground in grassy places. Peridium of the size of a large pea, pedicellate. The mouth plano-conic from adhering cilia which are at length revolute and free at the apex. The several lobes (of the outer peridium) elegantly revolute, from the entire arched base; where they touch the ground, fuscescent, white below, occu-

pying the space of ½ inch when expanded. Schweinitz evidently knew naught of chink or "*rima*."

De Toni in Revue Mycologique, 1887, p. 73, brings us, however, some help. De Toni, speaking of the Italian form, *G. marginatus* of Vittadini, says: "Cette espéce est donc une des plus petites du genre: elle diffère du *G. minimus* S. par la forme du peridium interne, et par la sillon autour du peristome." That is, "this species is one of the least of the genus: it differs from *G. minimus* by the form of the inner peridium and by the furrow around the peristome." Furrow or groove will do. The furrow, however, is owing to the elevation of a sort of marginal crest rather than to any marked depression around the areole.

Some years since, a tiny geaster was brought in, taken under a thicket of *Juniperus virginianus* L. The form closely resembles specimens of *G. minimus* Schw. but differs in several minor particulars. It is also like *G. marginatus* Vitt. but lacks the furrow.

It has seemed worth while to record this western form in order to make comparison of the three. It may be characterized as follows:

Geaster juniperinus sp. nov.

Outer peridium multifid, variable, 5–9-lobed; inner peridium ovate, elongate, pedicellate, white or bluish-white; stoma conic, ciliate, rising from a definite but only slightly depressed areole; columella stout; capillitial threads smooth, pallid by transmitted light, in diameter about 3μ; spores globose, warted, dark-brown, almost black in mass, about 3μ.

On the ground beneath juniper trees, Iowa. The figures on the accompanying plate, by Jessie Parish, show the slight differences separating the kindred forms.

The Schweinitzian species in all cases observed are more nearly spherical, with paler and more coarsely warted spores. Vittadini's, *i. e.*, the European type, is intermediate, has different spores, more elongate inner peridium, and depressed areole. The Iowa form differs in color, in spore-color and markings, approaching *G. minimus* in areole, and *G. marginatus* in other points of structure. The columella in *G. minimus* is almost nil; in *G. juniperinus* well developed, strong, and persistent.

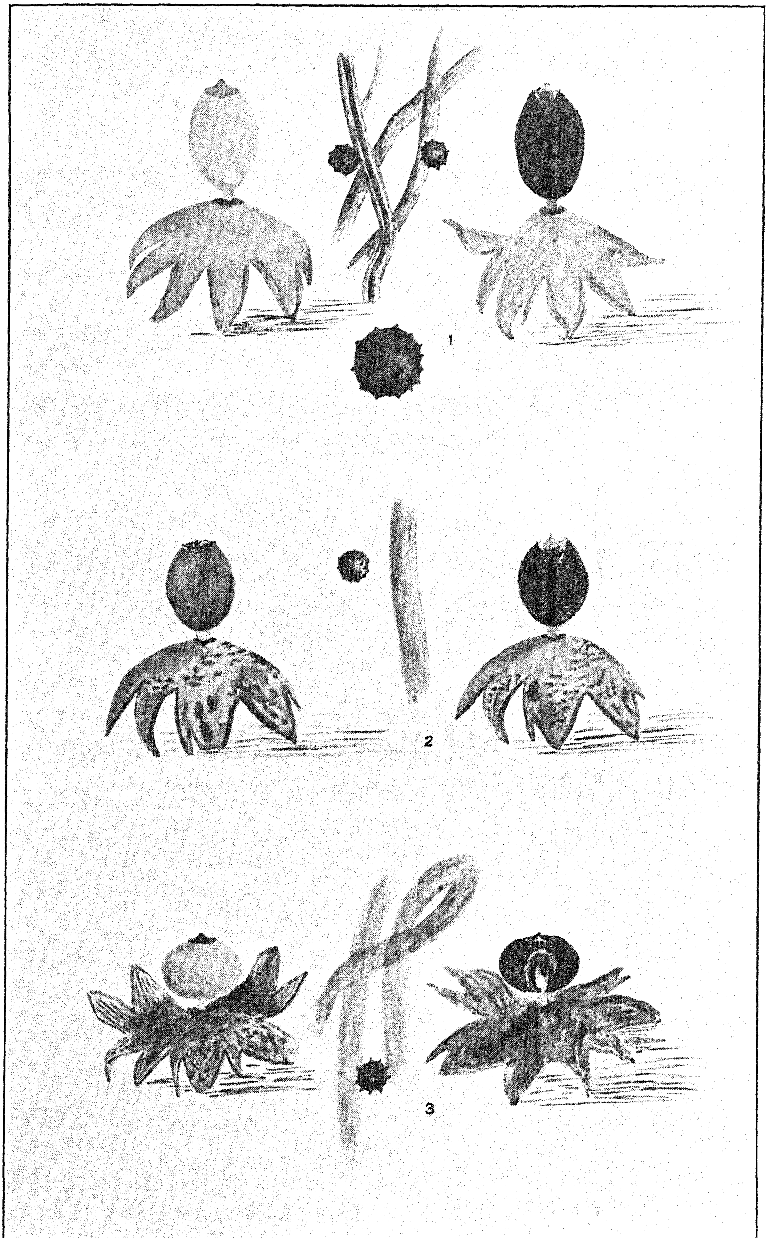
IOWA CITY, IOWA,
Oct. 20, 1911.

Explanation of Plate LXII

Fig. 1. *Geaster juniperinus* Macbride. Sporophore, × 1. Sporophore, showing section of inner peridium, × 1. Capillitium, threads and spores, × 1,130. A single spore, × 930.

Fig. 2. *Geaster marginatus* Vittadini. Sporophore, × 1. Sporophore, showing cross section of inner peridium, × 1. Capillitium, thread and spore, × 1,000.

Fig. 3. *Geaster minimus* Schweinitz. Sporophore, × 1. Sporophore, showing cross section of inner peridium, × 1. Capillitium, threads and spore, × 1,000.



1. GEASTER JUNIPERINUS MACBRIDE
2. GEASTER MARGINATUS VITTADINI
3. GEASTER MINIMUS SCHWEINITZ

THRAUSTOTHECA CLAVATA

W. C. Coker and O. W. Hyman

(With Plate 63, Containing 10 Figures)

During the course of our study of the Saprolegniaceae we brought into the laboratory early in January, 1911, a number of collections from promising pools and runs. Several different species developed in a couple of days. One of these taken from an open ditch in the arboretum was at once conspicuous on account of its stout hyphae and irregular branches. This soon developed club-shaped sporangia and by its method of spore liberation was at once recognized as the rare and interesting species *Thraustotheca clavata* (De Bary) Humphrey.

This mold seems not to have been found since its first discovery in 1880. In 1888 De Bary described it as a new species under the name of *Dictyuchus clavatus*.[1] He got his specimens from a collection of algal material taken in 1880 by Stahl from a fresh-water lake at Vendenheim near Strassburg, Germany, and kept it growing in his laboratory for four years. The species was really first published incidentally by Büsgen in 1882,[2] who in his study of the development of the sporangia described it sufficiently under the name of *Dictyuchus clavatus* De Bary sp. nov.

On account of the unparalleled method of spore liberation it was suggested by Solms-Laubach, who, after De Bary's death, arranged and edited his last paper, that this species might be considered as generically distinct from the other species of *Dictyuchus*. This was again remarked on by Fisher in 1892,[3] and the next year, Humphrey in his Saprolegniaceae of the United States was sufficiently impressed with its distinction to give it the generic name of *Thraustotheca*.

A pure culture of our Chapel Hill plant was obtained as fol-

[1] Bot. Zeitung 46: 649. 1888.

[2] Pringsheim's Jahrb. f. wiss. Botanik, 13: 253. 1882.

[3] Rabenhorst's Kryptagamen Flora 1: 365. 1892.

lows: A petri dish of sterilized agar-agar was inoculated with a drop of water containing free spores. After a few hours the spores sprouted. When the young fungus had grown sufficiently to be discernible with the naked eye it was cut out, together with the immediately surrounding medium and transplanted to a dish of fresh agar-agar. When the growth had become quite robust flies were inoculated, and fine cultures soon resulted. The species was kept growing and under observation for the rest of the term.

The main hyphae of *Thraustotheca* are stout, straight, and profusely branching into secondary hyphae near their tips. The secondary hyphae are much curved and twisted, and are often curiously knobbed and gnarled as shown in fig. 1. The main hyphae reach a length of 2 cm. in strong cultures, and vary in diameter from 20μ to 120μ averaging about 37μ. The sporangia are borne terminally, the hypha continuing from a sub-sporangial branch (fig. 2). The sporangia are typically short, broad, and clavate, differing from the sporangia of any other of the Saprolegniaceae. They vary from almost spherical on the one hand to fusiform on the other. The spores encyst within the sporangium immediately after they are formed. They are polyhedral in shape, through pressure, each having a hyaline membrane of its own (fig. 3). After the encysting of the spores, the sporangial wall, which has always been thin, begins to disappear, vanishing first as a rule on one side near the end of the club, and continuing to disintegrate until nothing is left of it except a narrow circular ring at the base. This basal ring may be quite conspicuous (figs. 4 and 5) or almost entirely absent.

This method of dehiscence is entirely unique among the water molds, and reminds us at once of the mold *Mucor* and its relatives. This resemblance was remarked on at the time the plant was described, and Solms-Laubach thought he saw another point of agreement between *Mucor* and our plant in the outward bulging of the basal partition. This, however, seems to us to be scarcely if at all noticeable in *Thraustotheca*. De Bary's figures show it scarcely at all, and neither do ours.

As the disintegration of the wall proceeds the spores fall apart irregularly. They then emerge from their cysts and swarm in

laterally biciliate form. Finally they encyst again and sprout. At the time of the final encystment the spores are of course spherical, measuring about 12.5μ in diameter.

The oögonia are borne singly on short, straight, perpendicular branches from the secondary hyphae, rarely from the primaries. At the time when the eggs are fully ripe the oögonia measure about 59μ in diameter. They are spherical, smooth, and very slightly pitted, the pits appearing only after staining with chlor-zinc-iodide. Each oögonium contains from 1 to 8 eggs (fig. 6). The usual number of eggs is either 4 or 6. Ripe eggs are spherical or slightly angular from pressure, excentric, with a single large peripheral oil globule (fig. 6). They are very constant as to size with a diameter of from 20μ to 22μ. The antheridial branches also arise from the secondary hyphae. They are long, very crooked, and quite stout. The ends of the antheridial branches become closely applied to the surface of the oögonium, and club-shaped antheridia are cut off from their tips (fig. 7). In many cases it was noted that the antheridium gave off a short tube which entered the oögonium and became applied to an egg (fig. 6). The actual fertilization of the egg was never seen but the antheridia were observed to become empty during the ripening of the eggs. In no case was it found that an antheridial tube became attached to an oögonium arising from the same hypha as itself.

The formation of the oögonia and eggs may be easily watched in this species. The protoplasm of the hypha flows out into the oögonial branch, rapidly packing it with densely granular substance. The tip of the branch swells into a rounded sphere which is packed with a very dense protoplasm. This tip is then cut off from the oögonial branch by a cross wall and the oögonium has been formed.

The substance within the oögonium is at first entirely homogeneous. After some time it may be noticed that oil drops are collecting at the periphery of the protoplasmic mass (figs. 7, 8, and 10). The protoplasmic mass then begins to divide, the division beginning at the center and traveling towards the periphery. At first a clear space appears in the center of the mass from which radial spaces gradually extend outward. The eggs when

first separated are roughly pyramidal in shape, their bases resting on the wall of the oögonium . Gradually the eggs become spherical and acquire a thick, hyaline membrane. When they first become spherical they show many oil globules situated on one side of the egg (fig. 10). These globules are at first only about 2μ in diameter, but they gradually fuse until there are only two or three larger ones from 8μ to 15μ in diameter. Finally these globules fuse into a single one, which is about 16μ in diameter, and situated at the periphery of the egg. The eggs are then ripe.

In old cultures an oögonium would often sprout a new one, the old being emptied into the new (fig. 9). This process might be repeated several times and the eggs be formed finally in the terminal oögonium (fig. 8).

Occasionally two oögonia were produced upon one branch, or an antheridial filament was found coming from an oögonial branch.

UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL, N. C.

EXPLANATION OF PLATE LXIII

Fig. 1. The tip of a main hypha showing the gnarled condition of the secondary hyphae. × 155.

Fig. 2. Main hypha showing sporangia and method of growth. × 155.

Fig. 3. Spores encysted within the thin-walled sporangium. × 700.

Fig. 4. Spores falling apart, the basal ring remaining. × 700.

Fig. 5. Usually large basal cup with a few spores still remaining in it. × 700.

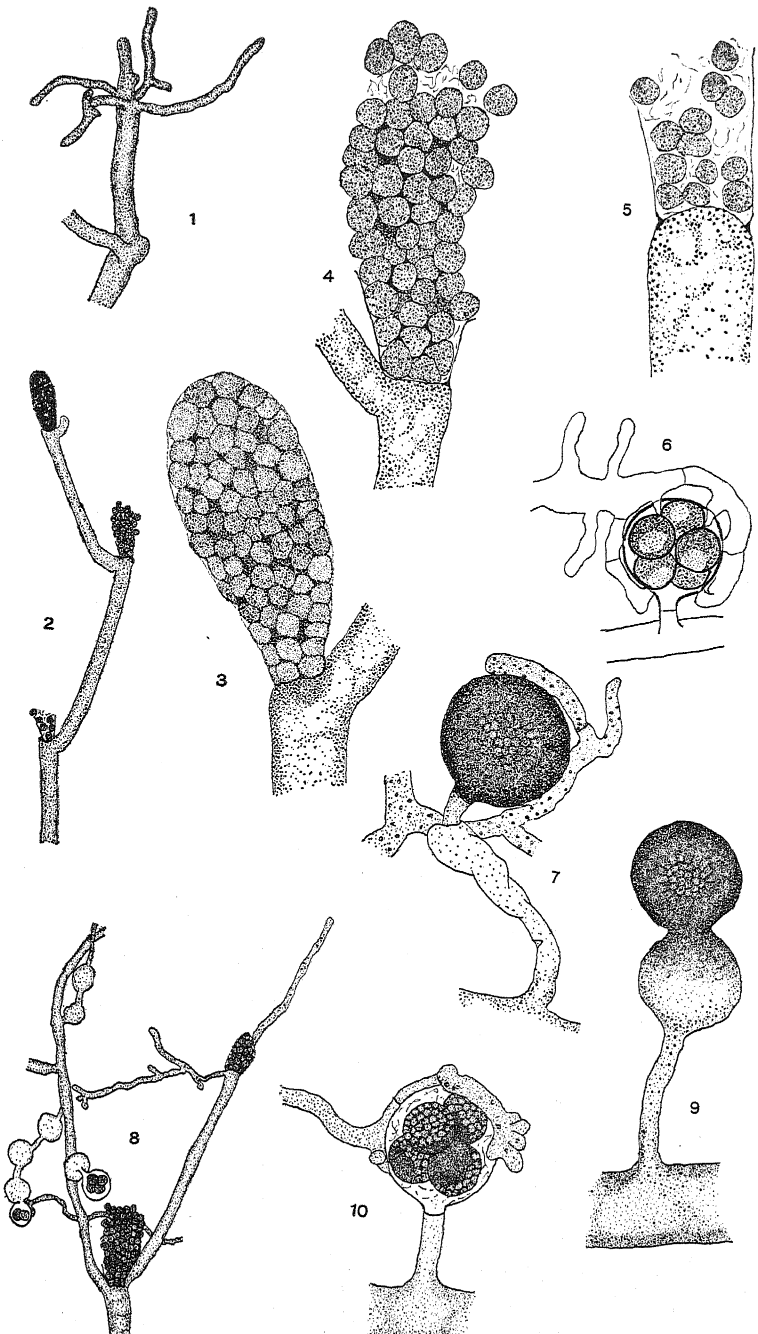
Fig. 6. Oögonium containing fully ripe eggs. Empty antheridia attached to the wall of the oögonium. × 700.

Fig. 7. Young oögonium with antheridium full of protoplasm. × 700.

Fig. 8. Showing double branching below the sporangia; antheridial branches; and new oögonia formed from old ones. × 700.

Fig. 9. New oögonium forming from old one. × 700.

Fig. 10. Oögonium with young eggs and young antheridium. × 700.



THRAUSTOTHECA CLAVATA (DE BARY) HUMPHREY

POLYPORACEAE AND BOLETACEAE OF THE PACIFIC COAST

William A. Murrill

The following list contains the species of pileate polypores and boletes collected by the writer on a recent tour of exploration through Washington, Oregon, and California. Mr. S. M. Zeller collected with me at Seattle and Tacoma; Professor L. S. Abrams assisted in exploring Preston's Ravine and La Honda. The localities and dates of the collections are as follows:

1. Seattle, Washington; virgin coniferous forests, peat bogs, and pastures. October 20–November 1, 1911.
2. Tacoma, Washington; virgin coniferous forests. ....October 26, 1911.
3. Tacoma Prairies, Washington; open barrens with clumps of young firs. October 26, 1911.
4. Glen Brook, Oregon; dense fir forests, 400–1000 ft. ..November 7, 1911.
5. Mill City, Oregon; virgin coniferous forest, 800–1200 ft..November 9, 1911.
6. Corvallis, Oregon; fir forests and mixed woods. ...November 6–11, 1911.
7. Newport, Oregon; virgin fir forest and sandy pine barrens. November 13, 1911.
8. Golden Gate Park, San Francisco, California; dry groves and shaded grassy banks. ....November 21, 1911.
9. Muir Woods, California; virgin forest of redwoods. ..November 22, 1911.
10. Preston's Ravine, near Palo Alto, California; redwoods and mixed forest up to 1000 ft. ....November 25, 1911.
11. La Honda, west slope of Santa Cruz Mountains, California; redwood forest below 1000 ft. ....November 25, 1911.

Tribe POLYPOREAE

Aurantiporellus alboluteus (Ell. & Ev.) Murrill. Found growing from the side of a decorticated red fir log, the pilei consisting chiefly of large, irregular tubes, and presenting a very different appearance from the original specimens found by Crandall inside of hollow *Abies* trunks in Colorado.
Seattle, *72*.

Bjerkandera adusta (Willd.) Karst. Found only on large-leaved maple.
Seattle, *65, 74*.

COLTRICIA PERENNIS (L.) Murrill. Quite common in dry, sandy places in woods.

Seattle, *44;* Tacoma, *68*.

CORIOLUS ABIETINUS (Dicks.) Quél. Common on dead coniferous trunks. No trace was found of *C. prolificans,* a near relative so abundant on deciduous wood in the eastern United States.

Seattle, *71;* Glen Brook, *757*.

CORIOLUS NIGROMARGINATUS (Schw.) Murrill. Rarely seen, but abundant in places.

Seattle, *46*.

CORIOLUS VERSICOLOR (L.) Quél. Common on oak and maple in Oregon and California. Not seen at Seattle.

Corvallis, *883;* Newport, *1075;* Preston's Ravine, *1163;* Muir Woods, *1149*.

Coriolus washingtonensis sp. nov.

Pileus small, dimidiate, sessile, laterally connate, slightly decurrent behind, sometimes effuse, tough, flexible, milk-white throughout, becoming slightly yellowish above on drying, and grayish behind with age, projecting about 5 mm. from the substratum, extending sometimes 10 cm. along cracks in the bark, reaching 5 mm. in thickness behind; surface azonate, smooth, subglabrous, margin undulate or lobed, sterile, rather thick for the genus; context thin, soft, flexible; tubes 1–4 mm. long, corky, mouths regular, glistening, slightly angular, 2 to a mm., edges thin, entire; spores ovoid, smooth, hyaline, $5 \times 3.5\mu$.

Growing from crevices in the bark of a dead log of *Thuya plicata*. It somewhat resembles *Coriolellus Sepium* in shape, but the pilei are scarcely semi-resupinate, the tubes are regular, and the context is much more flexible.

Seattle, *101* (*type*).

ISCHNODERMA FULIGINOSUM (Scop.) Murrill. Found once, on a decaying red fir log.

Seattle, *102*.

LAETIPORUS SPECIOSUS (Battar.) Murrill. Collected once, on an oak log, but not uncommon on the Coast.

Tacoma, *82*.

PHAEOLUS SISTOTREMOIDES (Alb. & Schw.) Murrill. Common about coniferous stumps, springing from decaying roots.
Seattle, *77;* Muir Woods, *1137*.

POLYPORUS ELEGANS (Bull.) Fries. Common about Seattle on fallen alder branches.
Seattle, *62, 86;* Corvallis, *885½*.

Scutiger oregonensis sp. nov.

Pileus ascending, depressed behind, reniform, irregular, fleshy-tough, solitary, 15 cm. wide, 25 cm. long, 3 cm. thick behind; surface dry, dark-fulvous, uniformly and densely imbricate-floccose-scaly, the ends of the scales either slightly upturned or at an angle of 45°, margin concolorous, fertile, lobed or undulate, bay when bruised; context white, nutty, thin, fragile when fresh, with the odor of musty meal when dry; tubes white, tinged with sulfur-yellow when bruised, decurrent, mouths regular, thin-walled, 1 mm. in diameter, edges uneven, toothed; spores ovoid, smooth, hyaline, $8–10 \times 5\,\mu$; stipe eccentric, inflated, 7 cm. long, 8 cm. thick, irregular, watery-white to flavous, turning sulfur-yellow when bruised, resembling the pileus above at the point of attachment and not reticulate behind.

This large and handsome species was collected November 9, 1911, on a rocky bank among giant red firs to the north of Mill City, Oregon, at an elevation of 1,200 ft. Its nearest relative is *Scutiger retipes*, known only from Alabama, from which it differs in many important characters.

Mill City, Oregon, *847* (*type*).

Spongipellis sensibilis sp. nov.

Pileus flabelliform-conchate, narrowly attached, tough, very juicy, white throughout, changing color very quickly when bruised or on drying, about 3–4 cm. long, 6 cm. broad, and 1.5–2 cm. thick behind; surface spongy-tomentose, azonate, somewhat uneven, changing at once to melleous when bruised and at length to bay, margin entire, regular, very sensitive to handling, thin, scarcely deflexed on drying; context duplex, white, thick, azonate and friable when dry above, zonate and woody below, changing color like the surface when bruised; tubes about equalling the thickness of the context, small, at first very white and glistening, changing quickly to bay when bruised, mouths circular, even, slightly angular, friable and easily corroded on drying, 4–5 to a mm., edges very thin, long-toothed, becoming lacerate at times; spores ovoid, smooth, hyaline, $5 \times 3\,\mu$.

This species was rather common about Seattle on fallen logs and branches of red fir in moist situations. At Glen Brook, Oregon, it was found on *Abies*. When touched, it turns at once to honey-yellow and later to bay, and some color approaching bay is usually assumed by all or a portion of the sporophore on drying. Paper touching the fresh specimens is stained ferruginous and then bay.

Seattle, *43* (*type*), *54*, *79*, *91*; Glen Brook, *791*; Corvallis, *996*.

TYROMYCES CAESIUS (Schrad.) Murrill. On dead trunks of *Abies grandis* and other conifers.

Seattle, *70*, *87*.

Tyromyces carbonarius sp. nov.

Pileus quite irregular in shape, varying from flabelliform to broadly sessile and laterally elongate, juicy, tough, fragile when dry, 1 × 1.5–3 × 0.5–1 cm.; surface tomentose to glabrous, uneven, white or hygrophanous, azonate, margin pale rose-tinted, rather thick, concolorous, narrowly sterile, undulate, rarely lobed; context white, tough to fragile; tubes equalling the thickness of the context, white within, mouths normally rather regular, subcircular, 4 to a mm., not glistening, edges white or pale rose-tinted, thin, sometimes irpiciform; spores oblong-ellipsoid, smooth, hyaline, 5 × 1.5–2 μ.

Collected on a burnt red fir log. The tubes may be very irregular at times, with long dissepiments, suggesting *Irpiciporus*. There is a faint roseate hue to the hymenium which is quite characteristic and rarely seen in species of this genus and its near relatives.

Seattle, *64* (*type*).

TYROMYCES CHIONEUS (Fries) Karst. Collected once, on an oak stump.

Corvallis, *904*.

Tyromyces cutifractus sp. nov.

Pileus usually broadly attached and laterally elongate, rarely flabelliform, slightly imbricate at times, 2–3.5 × 4–6 × 0.5–0.8 cm.; surface glabrous, white, often rough and unsightly because of the cracked and torn reddish-brown cuticle; context rather thick, firm, almost woody, but friable, milk-white; tubes slender, 2 or 3 times as long as the thickness of the context, white or

yellowish within and without, staining brownish when bruised, mouths glistening, small, quite regular, angular, edges entire, very thin; spores ellipsoid, smooth, hyaline, $6 \times 4 \mu$.

Type collected on a much decayed fir log in a virgin forest at Newport, Oregon. Also collected on a maple log and on the base of a living trunk of *Thuya* at Seattle. This disregard of essential differences between coniferous and deciduous wood is rather uncommon in fungi. The species is peculiar in having a brownish cuticle, gelatinous in appearance when wet, which breaks up as the pileus develops, leaving the surface very rough and unattractive in appearance, especially when plants are growing in moist situations.

Seattle, *55, 99;* Newport, *1064* (*type*).

Tyromyces perdelicatus sp. nov.

Pileus flabelliform to subcircular, varying with its position on the substratum, thin, fragile, milk-white throughout, 1–2 cm. broad; surface finely tomentose to glabrous, scarcely zonate, uneven, margin concolorous, thin, inflexed when dry; context very thin, white, fragile; tubes minute, glistening, mouths angular, subregular, edges very thin, slightly toothed, fragile; spores oblong-ellipsoid, smooth, hyaline, $7 \times 3 \mu$.

This small, snow-white species was collected several times at Seattle on fallen dead branches of conifers, and it was also found common at Glen Brook. The type specimens grew on *Tsuga heterophylla.*

Seattle, *45, 47* (*type*), *51, 53;* Glen Brook, *780.*

TYROMYCES GUTTULATUS (Peck) Murrill. Rare on coniferous stumps and logs. This species contains a bitter principle mi'dly resembling in taste the resin found in *Fomes Laricis.*

Seattle, *59;* Tacoma, *98.*

Tyromyces Pseudotsugae sp. nov.

Pileus imbricate-sessile, flabelliform to semicircular, $2\text{–}3 \times 2\text{–}3 \times 0.3\text{–}1$ cm.; surface milk-white, subglabrous, azonate or with zones faintly outlined, margin thin, concolorous, narrowly sterile, entire to slightly lobed, inflexed when dry; context thin, white, fragile; tubes varying greatly in length, those behind often reaching nearly 1 cm., mouths large, irregular, edges thin, fragile, toothed, collapsing, white, becoming yellowish on drying; spores ovoid, smooth, hyaline, $5 \times 3.5 \mu$.

Collected on a dead log of *Pseudotsuga taxifolia*.
Seattle, *84* (*type*).

TYROMYCES SEMIPILEATUS (Peck) Murrill. Common on fallen trunks and branches of alder and maple.

Seattle *58, 67;* Corvallis, *950;* Muir Woods, *1129;* Preston's Ravine, *1183*.

Tyromyces substipitatus sp. nov.

Pilei subcespitose, at times united above, irregularly subcircular or flabelliform, depressed, milk-white throughout, 2–4 cm. broad, 2–3 cm. high, 2–3 mm. thick; surface glabrous, uneven, lightly marked with irregular, radiating, raised lines, margin thin, concolorous, sterile, undulate or slightly lobed, slightly blackening when bruised; context fleshy, fragile when dry, very thin; tubes small, regular, fragile, collapsing, edges thin, toothed; spores ovoid, smooth, hyaline, $4 \times 2.5\mu$; stipe erect, lateral or subcentral, enlarging upward, reticulated on one side, owing to the undeveloped tubes, 1–2 cm. long, 2–4 mm. thick.

On rich soil mixed with humus, but not attached to wood. The species is aberrant, partly on account of its habit of growing upward from the ground, and might be classed with the stipitate forms of the polypores. It is closely related, however, to *Tyromyces semisupinus,* and may as well be placed in that genus as in any other.

Seattle, *75* (*type*).

Tribe FOMITEAE

CRYPTOPORUS VOLVATUS (Peck) Shear. Frequent on dead coniferous trunks.

Seattle, *80;* Glen Brook, *792;* Golden Gate Park, *1106*.

ELFVINGIA MEGALOMA (Lév.) Murrill. Common and abundant in every locality visited, usually on oak logs and stumps.

Seattle, *49;* Tacoma, *94;* Corvallis, *1001, 1008;* Muir Woods, *1151*.

FOMES ANNOSUS (Fries) Cooke. Found several times on logs and stumps of red fir. It is probably common on conifers but difficult to find because inconspicuous and often hidden.

Seattle, *89, 93;* Newport, *1089*.

FOMES LARICIS (Jacq.) Murrill. On fallen, much decayed logs of *Abies grandis,* about one-half way up from the base, at Tacoma; and growing from the center of the butt of an immense red fir log, at Mill City. Specimens from La Honda, collected by Crandall on a red fir stump, were examined at Stanford University. This species is more abundant in the far west than was formerly supposed.
Tacoma, *95, 104;* Mill City, *817.*

FOMES ROSEUS (Alb. & Schw.) Cooke. Very common on coniferous trunks, the sporophores sometimes reaching a foot in diameter.
Seattle, *60;* Corvallis, *917;* Newport, *1046.*

FOMES UNGULATUS (Schaeff.) Sacc. So abundant everywhere on coniferous trunks that only one collection was made.
Seattle, *85.*

PORODAEDALEA PINI (Thore) Murrill. Frequently found on red fir, and doubtless occurring on other conifers. The specimens from Glen Brook grew on a living red fir trunk over six feet in diameter.
Seattle, *90;* Glen Brook, *786;* La Honda, *1298.*

PYROPOLYPORUS IGNIARIUS (L.) Murrill. Common on trunks of living willows at Tacoma.
Tacoma, *100.*

Tribe AGARICEAE

GLOEOPHYLLUM HIRSUTUM (Schaeff.) Murrill. Found rarely, on dead conifers.
Seattle, *50, 61.*

LENZITES BETULINA (L.) Fries. Found once, on a dead oak limb ten feet from the ground.
Preston's Ravine, *1181.*

Family **BOLETACEAE**

Boletus Lakei sp. nov.

Pileus convex, often becoming plane, gregarious or subcespitose, rarely solitary, 8–12 cm. broad; surface fulvous with latericeous tints, appearing testaceous, densely imbricate-floccose-

scaly, owing to the rupture of the cuticle; margin white, sterile, entire, involute when young; context sulfur-yellow, unchanging or turning slightly yellowish-green when cut, with pleasant odor and mild flavor; tubes large, decurrent, elongate near the stipe, flavous when young, dark dirty-flavous with a greenish tint when older, unchanging when bruised; spores oblong-ellipsoid, smooth, yellowish-brown, 8.5–10.5 × 3.5μ; stipe subequal, 7 × 2 cm., flavous at the apex, then testaceous, then adorned with the ample, white, persistent, cottony annulus, and below this similar to the pileus in color and surface markings.

This species is similar to *B. luteus* and takes its place in the flora of the Pacific Coast; but the tubes are larger and the surface is floccose-scaly. At Corvallis it was very abundant in fir woods mixed with a few deciduous trees. It gives me pleasure to dedicate this handsome species to Professor E. R. Lake, of the Oregon Agricultural College, who some time ago sent me specimens for determination collected by him at Corvallis, November 29, 1907. This type collection was accompanied by notes and an excellent photograph.

Seattle, *113;* Glen Brook, *781;* Corvallis, *933, 999;* La Honda, *1293*.

CERIOMYCES COMMUNIS (Bull.) Murrill. Common about Seattle, but rare in other localities. Several varieties were found.

Seattle, *107, 115;* Mill City, *871;* Newport, *1084;* La Honda, *1295*.

Ceriomyces mirabilis sp. nov.

Pileus convex, spongy, solitary or gregarious, reaching 12 cm. in diameter; surface moist, bay, uniformily covered with conspicuous, projecting, conic, floccose, persistent papillae, which give it somewhat the appearance of bread-fruit; margin projecting like the eaves of a house, showing a yellow membrane 2–3 mm. wide; context citrinous, slowly changing to incarnate when bruised, very watery, drying with difficulty, tasteless; tubes large, greenish-yellow, uneven; spores fusiform, smooth, ochraceous-mellous, 19 × 7μ; stipe very bulbous, solid, bay and streaked below, strongly reticulate and latericeous above, the apex colored like the tubes, 15 cm. long, 1.3 cm. thick above, 3.5 thick below.

This remarkable species was found several times in the vicinity of Seattle on the ground in woods. It is one of the most difficult

species to preserve, owing to its extremely juicy consistency. It differs from nearly all other boleti in its floccose covering, which resembles that found on the surface of *Boletellus. Ananas* and *Strobilomyces strobilaceus,* but the scales are more rigid and conic in shape. The collector may readily distinguish it from these two species by its bay color and the absence of a veil. Both of the other species mentioned possess a conspicuous veil, and the former is tan to brown with a pinkish tint, while the latter is dark-brown or black. Mr. Zeller has photographed this species for me, and Mrs. Murrill made a very accurate colored sketch of it.

Seattle *106* (*type*), *108, 109*.

Ceriomyces oregonensis sp. nov.

Pileus convex, firm, solitary, 12 cm. broad; surface bay, even, not viscid, short-tomentose to subglabrous, 12 cm. broad, margin entire or slightly lobed, scarcely projecting: context firm, white, unchanging, mild, odor not characteristic; tubes very large, 2–3 mm. in diameter, depressed and radially elongate about the stem, ventricose, flavous to dull greenish-yellow, melleous within, not changing when bruised; spores oblong-ellipsoid, smooth, melleous, $10–12 \times 4 \mu$; stipe larger below, solid, white within, glabrous, not reticulate, very pale bay, 6.5 cm. long, 2 cm. thick at the center.

This species was collected on the ground in sandy pine barrens on the immediate coast at Newport, Oregon. Although growing in sand, the weather conditions were very humid.

Newport, *1039* (*type*).

CERIOMYCES VISCIDUS (L.) Murrill. Collected once, in sandy pine barrens. Very large, with bay-fulvous cap and rough, shaggy stem, flavous at the base.

Newport, *1099*.

Ceriomyces Zelleri sp. nov.

Pileus convex, firm, gregarious to subcespitose, 7–9 cm. broad; surface dry, uneven, bay, covered with a delicate bloom which disappears with age; margin regular, concolorous, somewhat projecting; context firm, cremeous, unchanging, drying easily, mild and slightly mucilaginous to the taste; tubes irregular, of medium size, pale-yellow to greenish-yellow, scarcely changing when

bruised; spores fusiform, smooth, ochraceous, averaging $12 \times 4.5\mu$; stipe bulbous, solid, red to purple, white or yellow at the base, more or less striate, furfuraceous, about 5 cm. long and 1.5 cm. thick.

This species was very common about Seattle, on rather dry banks in woods. When fully mature, the bloom on the cap disappears and the color is so dark that the sporophore is difficult to see unless a glimpse of the yellow hymenium is obtained. Mr. S. M. Zeller discovered the first specimens (No. 105), and I take pleasure in dedicating the species to him. Mr. L. S. Abrams found a number of specimens when we collected together at La Honda.

Seattle, *105* (*type*), *110, 111;* La Honda, *1299*.

ROSTKOVITES GRANULATUS (L.) Karst. Common at Newport in pine barrens, where both light and dark forms were found.

Tacoma Prairies, *114;* Newport, *1073;* Golden Gate Park, *1122*.

SUILLELLUS LURIDUS (Schaeff.) Murrill. Common under oaks on the edge of a lake near Tacoma. The form is perfectly typical, with lurid cap and red-dotted stem. Some of the caps are rimose-areolate above, much resembling *Ceriomyces communis*.

Tacoma, *112*.

NEW YORK BOTANICAL GARDEN.

NEWS AND NOTES

A new tropical laboratory for botanical and zoological research is soon to be established at Mayagüez, Porto Rico, with Dr. F. L. Stevens as director.

F. Guéguen, in *Comptes Rendus,* suggests that certain bodies found on the hyphae of a new species of Mucor are organs for the elimination of metabolic products.

In Publication 1 of the Botanical Society of Western Pennsylvania, D. R. Sumstine gives a list of eighty of the more conspicuous fungi collected within the limits of Pittsburg.

An article on nut diseases, by M. B. Waite (Proc. Am. Pomol. Soc. 182–190. 1911), treats several serious diseases of nut-bearing trees and suggests methods of control. Diseases of the pecan receive special attention.

Dr. P. Spaulding, of the division of Forest Pathology at Washington, has published a bulletin dealing in a very thorough manner with the life history of *Lenzites sepiaria* and its effects on timber. Under preventive measures, he recommends seasoning, floating, and infiltration with poisonous chemicals.

Dr. C. H. Kauffman has published in the Thirteenth Report of the Michigan Academy of Science, 1911, some very useful keys to the common genera of basidiomycetes and ascomycetes. His list of unreported Michigan fungi is also continued as in previous years.

The leaf-spot of orchids (*Hypodermium*), which begins at the apex of the leaf and gradually works downward until the entire leaf is killed, may be checked, according to F. T. Brooks, by

sponging the leaves with a dilute solution of potassium permanganate.

Mr. J. B. Rorer, mycologist of the Board of Agriculture, Trinidad, recently published an attractive illustrated annual report, treating several important tropical plant diseases and containing a preliminary list of Trinidad fungi, to which additions will be made from year to year.

An extremely handy volume by A. D. Selby on plant diseases, consisting of a general treatment, a special part on Ohio plant diseases, and a classified bibliography, has just come to us as Bulletin 214 of the Ohio Agricultural Experiment Station.

The commonest cause of the production of cancerous swellings known as "burs" on the trunks of rubber-trees (*Hevea*) in the Federated Malay States, according to Bancroft, is the wounding of the cortex by cart wheels and in other mechanical ways. Another cause seems to be the irritation from buds failing to develop into shoots. In this connection, the effect of insect work on the trunks of various trees might be investigated.

Professor J. C. Arthur and Dr. F. D. Kern spent the first week in January at the Garden consulting the mycological herbarium and library, and reading the final proof sheets of their next contribution to the literature of plant rusts, shortly to appear as volume 7, part 3, of NORTH AMERICAN FLORA.

The meeting of the various scientific societies of the country at Washington during Christmas week was a notable one and well attended. The botanists had very full programs, as well as a dinner and a smoker, in which between one hundred and two hundred took part. The Garden was represented by Dr. N. L. Britton, Dr. W. A. Murrill, Professor R. A. Harper, and Mr. A. B. Stout. A movement to unite all American botanical associations under the Botanical Society of America was auspiciously

inaugurated. The next meeting of the societies will be held in Cleveland; and the one following in Atlanta.

The pathological exhibits at the Washington Meeting were of great interest, and the room was an excellent meeting-place for botanists of all classes. The tables and walls were filled with specimens, cultures, charts, photographs, and colored drawings. Undoubtedly, this feature will require next year a larger room, with more chairs and tables, for the use of those desiring to make a careful study of the exhibits. It will also, let us hope, have a central location as it did this year, and be freely used by botanists at all times while the meeting is in progress.

The Swedish mycological Nestor, Professor Doctor Hampus von Post, died at Upsala, August 16, 1911, nearly 89 years of age. As is well known, he was one of the most diligent and assiduous contributors of Elias Fries. Not a few of the new species described in Fries' later works were detected and distinguished by him, and quite a number of Fries' Icones, both published and unpublished, were originally drawn by this "felicissimus fungorum investigator," who continued every year, even after Fries' death, and as long as his health and energy permitted, to collect, describe and illustrate species, varieties, and forms of the fungi growing around the agricultural college of Ultuna, where he was engaged during about 30 years. This accumulated work, of which nothing has been published since long ago, will no doubt be of great interest to those who have to deal with the Swedish fungous flora and will probably be adapted to throw light upon some of the problems which hitherto have remained unsolved.—*L. Romell.*

Notes on Some Papers Presented at the Washington Meeting, December 28 and 29, 1911

"Preliminary notes on a twig-blight of *Quercus Prinus*," by Della Ingram. This is due to a fungus producing pycnidia on the dead leaves and showing the *Macrophoma* type of spores. It also attacks white oak and chestnut to some extent. The disease

has been found in Connecticut, Pennsylvania, Maryland, and Virginia.

"Large leaf-spot of chestnut and oak," by A. H. Graves. A new leaf-spot, different from the common one caused by *Septoria ochroleuca*, has been found on chestnut and red oak in the entire south Appalachian region and also in Delaware. The spots, which begin to appear in August, are often an inch or more in diameter, and show concentric rings. Forty per cent. of the leaves are killed at times. Professor Farlow thinks the fungus is *Monochaetia Desmazierii* Sacc.

"Notes on *Cronartium ribicola*," by P. Spaulding. The teleutospores develop in the cool weather of autumn. Inoculations have been successfully made through the different hosts. No single inspection will remove all infected trees. If this disease is present, it will save expense to destroy all affected trees at once.

"An edible smut," by Mrs. Flora W. Patterson. Under this title, *Ustilago esculenta* P. Henn., on *Zizania latifolia*, was exhibited and described. Corn smut is used in large quantities in Mexico City as an article of food. A smut on sorghum is also edible..

"The potato *Fusarium* situation in Europe and America," by W. A. Orton. The speaker described three diseases involved: a wilt due to a species of *Verticillium*, a wilt due to *Fusarium oxysporium*, and another disease apparently physiological and very imperfectly known.

"The method of distribution of the olive knot disease," by Horne, Parker, and Daines. Experiments were conducted at Fair Oaks, California. Slime from knots caused new knots on inoculation. The causative organism is *Bacterium Savastanoi* E. F. Smith. It is distributed on the feet of birds, and may enter leaf-scars, cracks, wound callouses, and other rough places on the trunk. Smooth-barked varieties are therefore less subject to the disease.

"Notes on some diseased trees in our national forests," by G. G. Hedgcock. Large additions were made to the hosts and distribution of many of the larger tree-destroying fungi, such as *Inonotus dryophilus*, *I. texanus*, *Pyropolyporus Everhartii*, *P.*

igniarius, Fomes Laricis, F. fraxinophilus, Elfvingia fasciata, and *Porodaedalea Pini.*

"Silver leaf, a disease of fruit trees," by H. T. Güssow. This disease exists from one end of Canada to the other, as well as in many parts of Europe. It is caused by *Stereum purpureum,* acting within the trunk and branches, and is probably distributed by the transportation of lumps of mycelium from one tree to another during the process of cultivation.

"Observations on the deterioration and utilization of fire-killed timber in the Northwest," by J. R. Weir. The rots of coniferous timber were chiefly discussed. The blue-staining fungus is very important in burned trunks. If the sap was ascending when the fire occurred, there is more food and more rapid fungous growth. Standing trunks have more water, which prevents access of air and consequently retards fungous attack. The reason why few fungi are found on badly burned logs is due to the fact that the organic food substances are disorganized by the intense heat. Fires are often good for forests, ridding them of fungous pests. In places on the west of the continental divide, fungous infections sometimes totalled fifty per cent. or more.

"The use of soil fungicides to prevent damping off," by Carl Hartley. For coniferous seed-beds in sandy soil, apply three-sixteenths of a fluid ounce of commercial sulfuric acid in water to a square foot of surface, and water the beds twice a day during the germination period to prevent injury from the acid. This treatment does not apply to angiosperms. Pure acid is four times as effective as commercial.

"The relative merits of lime-sulphur, lead benzoate, and Bordeaux mixture for spraying potatoes," by F. C. Stewart and G. T. French. Bordeaux mixture was found to be by far the best, preserving the foliage, prolonging the life of the plant, and greatly increasing the yield. Lime-sulphur showed a dwarfing, rather than a stimulating effect; and lead benzoate had little or no effect.

"Some wood preservations, with special reference to their toxic properties," by C. J. Humphrey. Creosote is being thoroughly investigated at present, cultures of *Fomes annosus* being used to determine its toxic effects. Of the five fractions in creo-

sote, the middle ones are by far the most toxic. Common salt is an excellent preservative for inside timbers, where leaching is impossible.

"Experiments in the use of asphaltum and other substances as dressings for wounds of trees," by John Boddy. Lead paint has been tried thoroughly and found unsatisfactory unless applied at least once a year. Coal tar, the substance most used at present, has a caustic effect on the cambium and is also less durable than supposed. Asphaltum, or pure bitumen, derived from petroleum, is the very best dressing for trees of all kinds. It is applied hot from a kettle, as in the case of street-paving.

"The importance of sanitation in the control of certain plant diseases," by L. R. Jones. It is possible that we depend too much on spraying, to the neglect of sanitation. Diseases of cabbage were used in illustration. If the "yellows" (*Fusarium*) appears in a field, it rots all the heads and there is no chance of growing cabbage in that field even six years afterwards. The only hope is in one variety which appears resistant. Another field may show only "wilt" (*Phoma*), and still another only the common "black rot." Each disease is introduced locally and remains. Fields must be kept free of these diseases, and change of crops must be resorted to if necessary.

"The effect of *Gymnosporangium* upon the transpiration and photosynthesis of apple leaves," by H. S. Reed and J. S. Cooley. The authors reported quantitative experiments upon the transpiration and photosynthesis of healthy and diseased leaves. Transpiration records were taken in the field and photosynthesis records were taken in the laboratory by use of Ganong's photosynthometer. Both agreed in showing diminished activity on diseased leaves.

"The toxicity of plant acids and enzymes," by M. T. Cook and J. J. Taubenhaus. Laboratory experiments with picked fruits are not conclusive, owing to the fact that the enzymes which guard against fungi in the field may die after picking. For example, pears may contain living enzymes 45 days after picking, while in apples the death of the protecting enzymes may occur much sooner.

"A study of protoplasmic movements in fungi," by F. M. Andrews. The slow oscillations of the protoplasm in the aerial filaments of certain moulds grown in gelatin cultures were subjected to variations in heat and light and the influence of various gases and solutions. The transpiration optimum was found to be 23–26° C. Pure hydrogen gas, cold, darkness, glycerin solution, etc., caused the movements to gradually cease.

"Cardinal temperatures for germination of uredospores of cereal rusts," by E. C. Johnson. The optimum for *Puccinia graminis* and five other species was found to be 12–17° C. Higher temperatures retarded germination, hence there is less development in spells of hot weather. Professor Arthur would like to know why teleutospores will not grow. Out of 137 species, material of which seemed to be in perfect condition, he succeeded during one season in germinating only 37 for purposes of inoculation.

W. A. Murrill.

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PRELIMINARY NOTES ON THREE ROTS OF JUNIPER[1]

G. G. HEDGCOCK AND W. H. LONG

(WITH PLATES 64 AND 65, CONTAINING 15 FIGURES)

On account of the increasing scarcity of the common red cedar (*Juniperus virginiana*), other species of juniper which have heretofore been considered worthless or of very little economic value are becoming commercially important. Any disease, therefore, which seriously injures any species of juniper that reaches a size large enough to be used even for fence posts, is of sufficient importance to demand attention.

In addition to the three rots caused by the species of *Fomes* which are discussed in this paper, there are also other rots of juniper which do much damage, but lack of sufficient data and material at this time on these diseases have made it necessary for the writers to limit this article to three heart rots of living junipers, namely: white rot, caused by *Fomes juniperinus;* yellow rot, caused by *F. earlei;* and stringy brown rot, caused by *F. texanus*.

The distribution and characteristics of the white rot, and the damage done by it to the red cedar have been previously noted by von Schrenk (Two Diseases of Red Cedar, Caused by *Polyporus Juniperinus* n. sp., and *Polyporus Carneus* Nees, Bull. 21, U. S. Dept. Agr. Veg. Phys. and Path.). The characteristics and effects of the other two rots are here reported for the first time;

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technical descriptions of the sporophores, however, have been given by Murrill in North American Flora 9: 104, 107. 1908.

The junior author is responsible for the descriptions given, and for the micro-chemical studies of the rots reported in this article. The field notes on *Fomes earlei* and *F. texanus* were made by both authors.

WHITE HEART ROT OF JUNIPER

FOMES JUNIPERINUS (Schrenk) Sacc. & Syd. Sacc. Syll. **16**: 151. 1902

Polyporus juniperinus Schrenk, Bull. U. S. Dept. Agr. Veg. Phys. and Path. **21**: 9. 1900.

Pyropolyporus juniperinus (Schrenk) Murrill, Bull. Torrey Club **30**: 116. 1903.

Rot white, or brownish-white in partially rotted areas, forming holes in the heart wood. These holes have white borders consisting of delignified wood tissues, which rather abruptly change both in structure and color until the normal condition of the sound wood is reached. Long, white fibers of pure cellulose extend into the cavity, which usually contains a yellowish mass, consisting of wood fibers intermixed with the mycelium of the fungus. The holes vary from one to three inches in diameter and extend longitudinally in the tree for several inches (4–6); or successive holes may coalesce into one long hole; or there may be several holes in one cross section. The white delignified tissue that borders the holes is firm and appears to be sound, but a microscopic examination shows that the middle lamellae and medullary rays have disappeared, leaving the individual tracheids with walls of pure cellulose. The bordered pits are also corroded until they appear as regular perforations in the tracheids.

Later the delignified wood is gradually destroyed, thus producing the holes in the trees. There seems to be a radial limit to the activity of this fungus as the holes increase in size up to a certain diameter, beyond which all enzymotic action stops and the hole ceases to grow in diameter, but may continue to grow longitudinally. Around the edges of such holes the delignification and the absorption of the resulting cellulose seem to progress at about the same rate, as the attacked wood gives only a faint reaction for pure cellulose. This description is made from a portion of the type material of the rot.

Pileus woody, ungulate, length 3–7 cm., breadth 5–9 cm., thick-

ness 2–4 cm., narrowly attached; surface tomentose, sulcate, reddish-brown to dark brown; margin obtuse, velvety, melleous to ferruginous, plane below; context woody, reddish-brown, 0.5 to 2 cm. thick; tubes indistinctly stratified, 0.5 to 1 cm. long each season, melleous within, reddish-brown in older layers, mouths circular, 2–3 to a millimeter, edges obtuse, entire, melleous to fulvous; spores very abundant, fulvous, smooth, spheroid to broadly ellipsoid, somewhat angular, $5\text{–}6 \times 6\text{–}7\,\mu$, cystidia few, nearly colorless, $100 \times 20\,\mu$, pointed (in specimen at hand), somewhat encrusted. This description is drawn from a specimen collected at Sparrow Point, Md., by Dr. Perley Spaulding in 1908.

TYPE LOCALITY: Tennessee.

HABITAT: Trunks of living trees of *Juniperus virginiana* L.

DISTRIBUTION: Tennessee, Kentucky, and Maryland, probably more or less prevalent throughout range of host. Only 3 or 4 sporophores of this fungus have ever been reported, but the rot is known to occur in the states mentioned. The sporophores form from a dense whitish weft of mycelium, which has grown out through the wood of a dead branch or from a knot hole.

YELLOW ROT OF JUNIPER

FOMES EARLEI (Murrill) Sacc. & D. Sacc. Sacc. Syll. **17**: 119. 1902

Pyropolyporus Earlei Murrill, Bull. Torrey Club **30**: 116. 1903.

Rot light brown, slightly paler than the unchanged heart wood, forming longitudinal holes from one to several inches in diameter and two to several inches in length; holes, as a rule, partially filled with undecomposed wood particles which are often matted together by the light yellow mycelium of the fungus; rotted areas usually abruptly limited by annual rings, thus making longitudinal tube-like holes several times longer than broad; both heart and sap wood may be attacked, but usually only the heart wood.

The enzym from this fungus attacks the medullary rays and the walls of the bordered pits, gradually enlarging the pits until only clear round holes are left. These holes gradually coalesce, and the tracheids are thus divided longitudinally, leaving jagged strips of tissue, the uncorroded corner remnants of the walls where three or more tracheids joined. The enzym does not delignify the walls of the tracheids but corrodes the tissues as a whole; neither are the middle lamellae destroyed as in the white rot of juniper.

Pileus woody, broadly ungulate to semi-cylindrical in old sporo-

phores, broadly attached, plane to slightly convex below, length 2–12 cm., breadth 3–12 cm., thickness 2–8 cm.; surface concentrically sulcate, very rimose, fulvous to brownish-black; margin broad, obtuse, luteous to dark brown, tomentose; context woody, fulvous, at length becoming dark reddish-orange, 1 to 1.5 cm.; tubes faintly or not at all stratified, from 1 cm. long in very young sporophores to .2–.5 cm. in older ones each season, 1 to 2 to a millimeter, yellow within during first season, later becoming brick-red, mouths circular, yellow, edges obtuse, thin; spores very abundant, spheroid, broadly ovoid or ellipsoid, smooth, $5–6 \times 6–8\,\mu$, pale yellow, cystidia apparently none.

TYPE LOCALITY: El Capitan Mountains, New Mexico, at an altitude of 2100 meters.

HABITAT: Trunks of living trees of *Juniperus monosperma* (Eng.) Sarg., *J. utahensis* (Eng.) Lemm., and *J. sabinoides* (H.B.K.) Sarg.

DISTRIBUTION: Texas, New Mexico (very common), Arizona, and Colorado.

The sporophores of this fungus are fairly common wherever the rot is found, and are attached directly to the bark on areas where the rot has reached the surface of the tree. They are located usually within ten feet of the ground in narrow longitudinal furrows or depressions in the trunk. The damage to the trees is often extensive; in some instances the trees are weakened to such an extent, especially near the butt, that they bend or break at this point; in any event a tree thoroughly infected by this fungus is unfit for commercial purposes. This rot is apparently rare in Texas, as only one sporophore has been found. It is replaced here by *Fomes texanus*.

STRINGY BROWN ROT OF JUNIPER

Fomes texanus (Murrill) Hedgc. and Long

Pyropolyporus texanus Murrill, N. Am. Fl. 9: 104. 1908.

Rot reddish-brown, light brown adjacent to the sound wood, characterized by layers of badly rotted wood alternating with more or less sound layers. The rotted regions correspond approximately to the spring wood of the annual rings and the sound layers to the summer wood, thus making a species of stringy brown rot arranged in concentric rings in a cross section view.

In the earlier stages of the rot, the wood is light brown and under the hand lens is seen to consist of small pockets of rotting tissue in the spring wood, thoroughly permeated with the fulvous mycelium of the fungus; at this stage the rot somewhat resembles that produced by *Polystictus abietinus*. As the rot advances, these pockets coalesce longitudinally, thus destroying more or less completely the spring wood.

This rot, from the material at hand, does not seem to produce holes in the tree but leaves the wood in the alternate-layered condition above described. Later, certain fungi, especially species of *Poria*, may attack and completely destroy the diseased wood, thereby leaving the tree in a more or less hollow condition. This fungus usually attacks only the heart wood, but also extends into the sap wood, a condition which always arises wherever a sporophore is formed. The entire heart wood for many inches may be attacked and take on the characteristic reddish-brown layered appearance previously noted.

A micro-chemical examination of the diseased wood shows no delignification, but the enzym seems to attack first the resinous or gum-like contents of the medullary rays, then their walls and thence passes to the tracheids, where small areas in the spring wood are destroyed. The middle lamellae are not attacked by the enzym, but the walls of the tracheids seem to be uniformly corroded, the relative proportion of lignin, cellulose, etc., in their walls changing not at all. This description was made from material collected at Austin, Texas (type locality), on *Juniperus sabinoides,* but the characteristics of the rot are the same on all the hosts examined.

Pileus woody, more or less ungulate to sub-cylindrical in very old specimens, broadly attached, plane to slightly convex below; length 3–13 cm., breadth 4–11 cm., thickness 2–6 cm.; surface, when young, tomentose, melleous, smooth, becoming sulcate by the yearly accretions, older portion reddish-brown to black, glabrate, strongly rimose; margin very obtuse, rounded, melleous, tomentose, smooth; context woody, melleous to dark luteous, zonate, 1.5–2.5 cm. thick; tubes evenly but faintly stratified, 3 to 5 mm. long each season, concolorous without luster, mouths circular, 4–5 to a millimeter, edges obtuse, entire, melleous to fulvous; spores rarely found, globose, smooth, 3–4 μ, cystida none, hyphae brown, 5–7 μ in diameter.

TYPE LOCALITY: Austin, Texas, on *Juniperus sabinoides.*

HABITAT: Trunks of living trees of *J. sabinoides, J. monosperma,* and *J. utahensis.*

DISTRIBUTION: Southwest Texas, New Mexico, and Arizona. Very common in Texas and New Mexico.

The sporophores are attached to the bark, usually within ten feet of the ground, and occur on dead tissue where the fungus has grown outward from the heart wood into the bark, thereby killing the living tissues of the tree, at this point both sap wood and bark are permeated with the reddish-yellow mycelium of the fungus. The sporophores are usually located in the longitudinal depression or furrows which are found on most junipers. They were rarely found associated with an old dead branch or knot hole. The damage done by this rot in certain localities is very great; often many mature and over-mature trees are weakened at the butt to such an extent that they bend, split, and flatten near the ground and either fall or remain in a leaning position; later other fungi or fire kills the trees outright or hollows them out so that they are easily blown down. Even when the injury is not sufficient to produce such damage, the wood of many trees attacked by this fungus is rotted to such an extent that it is unfit for commercial purposes.

OFFICE OF INVESTIGATIONS IN FOREST PATHOLOGY,
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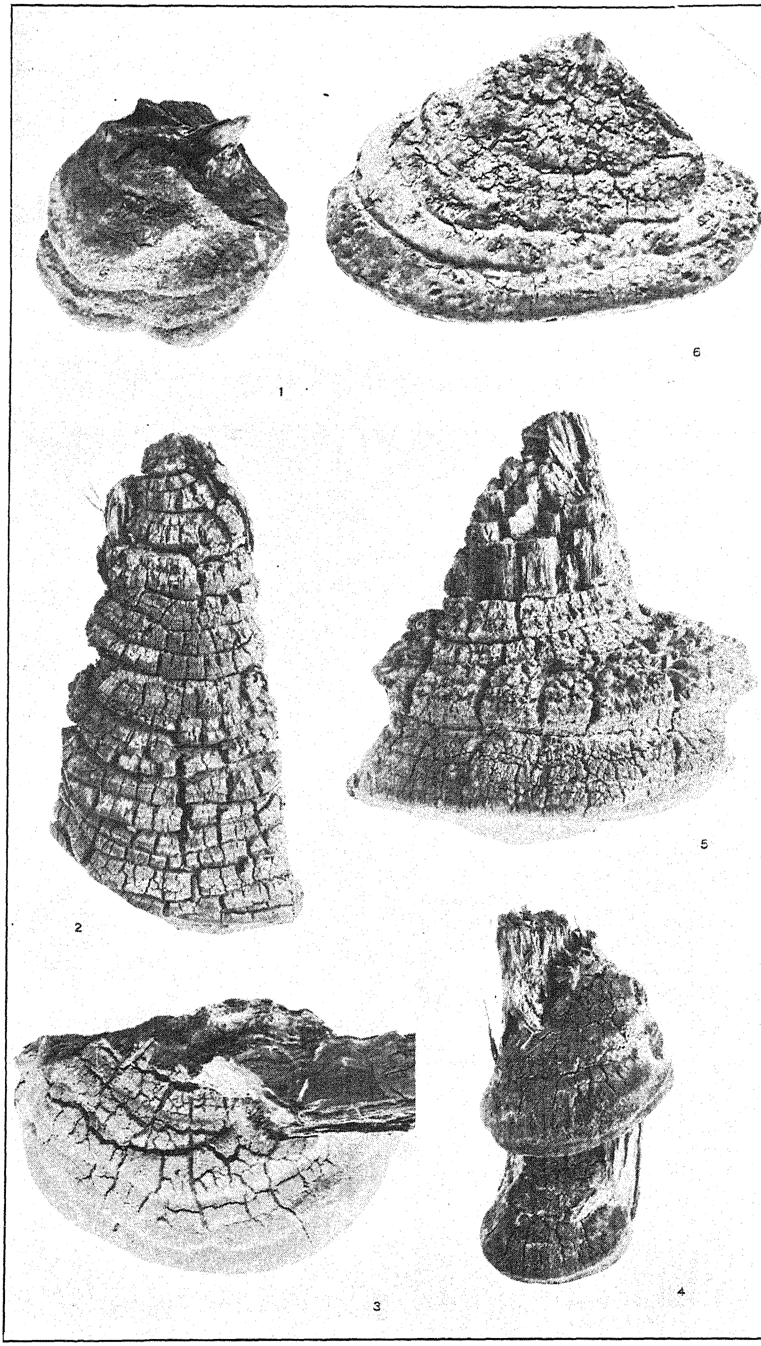
EXPLANATION OF PLATE LXIV

Fig. 1. Sporophore of *Fomes juniperinus.* × ½.
Fig. 2. Sporophore of *Fomes texanus,* old and weathered specimen. × ½.
Fig. 3. Sporophore of *Fomes texanus,* young specimen two or three years old. × ½.
Fig. 4. Sporophore of *Fomes earlei,* young specimens one or two years old. × ½.
Fig. 5. Sporophore of *Fomes earlei,* old and weathered specimen. × ½.
Fig. 6. Sporophore of *Fomes earlei,* young specimen three or four years old. × ½.

EXPLANATION OF PLATE LXV

Fig. 1. *Fomes texanus,* longitudinal section of sporophore. × ½.
Fig. 2. *Fomes earlei,* longitudinal section of sporophore. × ½.
Fig. 3. *Fomes juniperinus,* longitudinal section of sporophore. × ½.
Fig. 4. *Fomes texanus,* surface of hymenium showing pores. × 2.
Fig. 5. *Fomes earlei,* surface of hymenium showing pores. × 2.
Fig. 6. *Fomes juniperinus,* surface of hymenium showing pores. × 2.
Fig. 7. *Fomes texanus,* longitudinal section of wood showing rot. × ½.
Fig. 8. *Fomes earlei,* longitudinal section of wood showing rot. × ½.
Fig. 9. *Fomes juniperinus,* longitudinal section of wood showing rot. × ¼.



POLYPORES THAT ATTACK JUNIPER

THE GENUS LASIOSPHAERIA

FRED J. SEAVER

(WITH PLATES 66 AND 67, CONTAINING 37 FIGURES)

In working over the Trichosphaeriaceae preparatory to a monograph of the family a number of points of interest have arisen relating both to genera and species. In order to bring out some of these points the North American species of the genus *Lasiosphaeria* are here described and illustrated.

The genus *Lasiosphaeria* was founded in 1863 by Cesati and De-Notaris, with *Sphaeria ovina* Pers. as type of the genus. In 1869 Fuckel took up the genus *Leptospora* Rabenh. but used it in a different sense from that in which it was originally used by Rabenhorst,[1] including *Sphaeria ovina* Pers. in this genus. In the diagnosis of the genus *Leptospora* Fuckel states: "Diese Gattung steht, was den Sporenbau anbelangt, *Lasiosphaeria* nahe, nur sind bei *Leptospora* die Sporen ohne Querwänden." In the members of this group of plants it is very difficult to rely upon the septation of the spores as a basis for generic distinction since in many species the spores are nonseptate when young and it is difficult to find mature spores, but when mature spores are found, they are often delicately separate. The type of the genus *Lasiosphaeria* as usually collected has nonseptate vermiform spores while rarely plants of the same species are found with some of the spores enlarged at one end into an ellipsoid head and becoming one or more septate. Other species of the genus which usually contain nonseptate spores occasionally have the spores septate without enlargement, the number of septa varying with the species. While Fuckel in his diagnosis of the genus *Leptospora* regards the spores as nonseptate he includes in the genus species in which, as described above, the spores are often septate. The genus *Leptospora* of Fuckel is therefore regarded as a synonym of *Lasiosphaeria*, in which genus the presence or absence of septa is a variable character.

[1] Hedwigia 1: 116. 1857.

Since the genus *Lasiosphaeria* was founded numerous species have been placed in the genus which more properly belong with other genera of the Trichosphaeriaceae. The genus, therefore, as here treated is used in a somewhat restricted sense to include the species which, in the judgment of the writer, properly belong here. While as a rule the members of the genus have hairy perithecia in a few the perithecia are not conspicuously hairy at least when old. The delicate walled, long and usually vermiform spores constitute one of the most valuable diagnostic characters of the genus.

So far as the form and variability of the spores is concerned this group shows a very close relationship with the Fimetariaceae (Sordariaceae), the chief difference being in the consistency of the perithecia which may be due in part at least to the difference in substratum. Referring to *Pleurage albicans,* Griffiths[2] says: "A very interesting species from the fact that mature spores are seldom met with. . . . Often one may find asci in which the spores are slightly enlarged at the end, but it is seldom that they can be found in even the olive-green stage. In the vast majority of cases they are simply the long cylindrical curved guttulate structures that are the forerunners of the spores of so many of the species of the genus." The same statement will apply equally well to several species of the genus *Lasiosphaeria* as shown by the illustrations accompanying the present paper. While *Pleurage lutea* (Ellis & Ev.) Kuntze which occurs on wood is commonly placed with the Fimetariaceae it is doubtful whether it should not more properly have been placed in the genus *Lasiosphaeria* with the family Trichosphaeriaceae. As a whole the present genus shows a rather close relationship with the genus *Pleurage* of the Fimetariaceae.

As the present paper is preliminary to a treatment of the family Trichosphaeriaceae in North American Flora, any data regarding additional species in the genus *Lasiosphaeria* or notes regarding the extension of range of distribution of any of the species here described will be very gladly received.

[2] North American Sordariaceae. Mem. Torrey Club 11: 80. 1901.

LASIOSPHAERIA Ces. & De-Not. Comm. Soc. Critt. Ital. 1: 229. 1863

Leptospora Fuckel, Symb. Myc. 143. 1869. ?Not *Leptospora* Rabenh. 1857.

Perithecia superficial, free or seated in a subiculum consisting of a black or dark brown mycelial growth, cylindric, globose, ovoid or pyriform, brownish or blackish or occasionally light colored by reason of the pale hairs with which they are clothed, or clothed with black hairs; hairs rigid or flexuous, few or abundant; asci cylindric or clavate, usually 8-spored; spores very variable, usually vermiform with a delicate appendage at either end, hyaline or colored a part of their length, or often with an enlarged head which may be hyaline or dark brown in color, simple at first but often becoming at maturity delicately septate; septa variable in number or in some species constant.

Type species, *Sphaeria ovina*.

Spores uniformly hyaline or subhyaline throughout their entire length.
  Perithecia clothed with light colored hairs giving them a grayish or yellowish appearance.
    Hairs scant, flexuous, varying from yellowish to whitish. — 1. *L. mucida.*
    Hairs abundant, rigid, giving the perithecia a spiny appearance.
      Neck of the perithecia simple. — 2. *L. strigosa.*
      Neck of perithecia compound, four-parted. — 3. *L. stuppea.*
  Perithecia clothed with black hairs.
    Perithecia subglobose to pyriform.
      Hairs abundant, rigid, giving the perithecia a spiny appearance.
        Spores 50–80 × 6 μ, becoming 7-septate.
          Plants occurring on wood. — 4. *L. hispida.*
          Plants occurring on soil. — 5. *L. terrestris.*
        Spores 65–70 × 3–4 μ, becoming many-septate. — 6. *L. multiseptata.*
      Hairs scant, spores small, 20 × 4 μ. — 7. *L. globularis.*
    Perithecia flat below, depressed-conic. — 8. *L. jamaicensis.*
Spores dark brown a part of their length.
  Colored portion of spore enlarged into an ellipsoid head. — 9. *L. newfieldiana.*
  Colored portion of spore not enlarged. — 10. *L. dichroöspora.*

1. **Lasiosphaeria mucida** (Tode)

Sphaeria mucida Tode, Fungi Meckl. **2**: 16. 1791.
Sphaeria mutabilis Pers. Ic. Descr. Fung. 24. 1798.
Sphaeria ovina Pers. Syn. 71. 1801.
Leptospora ovina Fuckel, Symb. Myc. 143. 1869.
Lasiosphaeria ovina Ces. & De-Not. Comm. Soc. Critt. Ital. **1**: 229. 1863.

Perithecia superficial, gregarious or often crowded, nearly globose with a more or less prominent ostiolum, about .5 mm. in diameter, clothed externally with a fine white or yellowish tomentum except the ostiolum which appears as a black dot, the entire perithecium becoming darker with age, at length brownish or blackish, hard and carbonaceous; asci cylindric or clavate, 8-spored, surrounded by a yellow mucilaginous substance, 150–200 $\times$ 15–20 μ; spores cylindric, or vermiform, usually abruptly curved near the lower end, hyaline, simple or indistinctly septate or pseudoseptate, often with a delicate appendage at either end and occasionally with one end swollen forming a conspicuous head, 35–50 $\times$ 3–5 μ (*pl. 2, f. 1–3*).

On rotten wood.

TYPE LOCALITY: Mecklenburg, Germany.

DISTRIBUTION: Maine to Colorado, Florida and Louisiana.

ILLUSTRATIONS: Tode, Fung. Meckl. *pl. 10, f. 82;* Pers. Ic. Descr. *pl. 7, f. 6.*

EXSICCATI: Ellis, N. Am. Fungi *892*.

2. LASIOSPHAERI STRIGOSA (Albert. & Schw.) Sacc. Syll. Fung. **2**: 201. 1883

? *Sphaeria canescens* Pers. Obs. Myc. **8**: 67. 1796.
Sphaeria strigosa Albert. & Schw. Consp. Fung. 37. 1805.
Leptospora strigosa Fuckel, Symb. Myc. 144. 1869.
? *Lasiosphaeria canescens* Karst. Myc. Fenn. **2**: 162. 1873.
? *Sphaeria sublanosa* Cooke; Cooke & Ellis, Grevillea **7**: 41. 1878.
? *Metasphaeria sublanosa* Sacc. Syll. Fung. **2**: 165. 1883.
Lasiosphaeria Hystrix Ellis & Ev. Proc. Acad. Nat. Sci. Phil. **1894**: 326. (1895?)

Perithecia thickly gregarious and occasionally crowded, subglobose to ovoid, black, clothed externally with stout rigid yellowish hairs; hairs acute or subacute, 12–14 μ in diameter near the

base with a narrow cavity extending longitudinally through the center, pale yellow with the microscope; asci clavate, 8-spored, about $100 \times 15–18\,\mu$; spores 2-seriate or irregularly crowded, cylindric or cymbiform with acute ends, hyaline or pale yellowish, $25–30 \times 5–6\,\mu$, granular within and often pseudoseptate near the center (*pl. 1, f. 4–7*).

On rotten wood.

TYPE LOCALITY: Europe.

DISTRIBUTION: New Jersey to Ontario and Ohio.

ILLUSTRATIONS: Albert. & Schw. Consp. *pl. 5, f. 7;* Berl. Ic. Fung. **1**: *pl. 107, f. 2.*

3. LASIOSPHERIA STUPPEA Ellis. & Ev. Bull. Washburn Lab. Nat. Hist. 1: 4. 1884

Perithecia superficial, gregarious, ovoid, about 1 mm. in diameter, densely clothed with light brown hairs; hairs simple, flexuous, blunt, with small central cavity, pale yellowish with transmitted light, $200–400\,\mu$ long and about $6\,\mu$ in diameter; ostiolum strongly 4-ribbed giving the appearance of a cluster of four perithecia imbedded in a stroma; asci clavate, 8-spored, $18–20\,\mu$ in diameter and about $200\,\mu$ long; spores partially 2-seriate, elongate-ellipsoid, $30–38 \times 8–10\,\mu$, hyaline or slightly yellowish at maturity, with 1–3 oil-drops (*pl. 1, f. 8–11*).

On dead wood of *Tsuga Pattoniana.*

TYPE LOCALITY: Mt. Paddo, Washington.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Ellis & Ev. N. Am. Pyrenom. *pl. 19, f. 5–10.*

4. LASIOSPHAERIA HISPIDA (Tode) Fuckel, Symb. Myc. 147. 1869

Sphaeria hispida Tode, Fungi Meckl. **2**: 17. 1791.
Sphaeria Rhacodium Pers. Syn. Fung. 74. 1801.
Sphaeria hirsuta Pers. Ann. Bot. Usteri **11**: 24. 1794.
Sphaeria emergens Schw. Trans. Am. Phil. Soc. II. **4**: 212. 1832.
Lasiosphaeria hirsuta Ces. & De-Not. Comm. Soc. Critt. Ital. **1**: 229. 1863.
Lasiosphaeria Rhacodium Ces. & De-Not. Comm. Soc. Critt. Ital. **1**: 229. 1863.
? *Sphaeria orthotricha* Berk. & Curt. Grevillea **4**: 108. 1876.

Perithecia gregarious, seated on a more or less well developed subiculum consisting of a black mycelial growth, ovate to pyriform, black, roughened and abundantly clothed with hairs; hairs black to the unaided eye, very dark brown with the microscope, long and flexuose near the base and shorter and more or less rigid above, blunt or subacute, simple or sparingly septate, the shorter hairs about 50–80 μ in length and 6 μ in diameter, quite variable in length; substance of the perithecium tough, black and opaque; asci cylindric or clavate, 8-spored; spores 2-seriate or irregularly crowded, long vermiform, often abruptly curved near one end, hyaline, becoming pale brown with 8–10 large distinct oil-drops, for a long time simple, finally becoming delicately 6–7-septate, usually with one septum between each two oil-drops, 50–80 $\times$ 6–8 μ (*pl. 2, f. 1–7*).

On rotten wood.

TYPE LOCALITY: Mecklenburg, Germany.

DISTRIBUTION: New York to Montana, Colorado and Alabama.

ILLUSTRATIONS: Tode, Fungi Meckl. **2**: *pl. 10, f. 84*; Rabenh. Krypt. Fl. **1**[1]: 194, *f. 1–3*.

EXSICCATI: Ellis, N. Am. Fungi *893;* Ellis & Ev. Fungi Columb. *116, 3314;* Shear, N. Y. Fungi *359*.

5. LASIOSPHAERIA TERRESTRIS (Sow.) de Thüm. Myc. Univ. 1744. 1881

Sphaeria terrestris Sow. Brit. Fungi *pl. 373, f. 7*.

Perithecia scattered or gregarious, black or brownish black, nearly globose, about .5 mm. in diameter, clothed externally with a rather dense covering of rigid black hairs; hairs 7–8 μ in diameter at the base, rather blunt and about 200 μ long; asci clavate, 8-spored; spores vermiform, crowded in the ascus, 65–70 $\times$ 6 μ, hyaline, multiguttulate, often with the end enlarged, becoming pale brownish at maturity and with several delicate septa (*pl. 2, f. 10–12*).

On soil.

TYPE LOCALITY: Great Britain.

DISTRIBUTION: Ohio; also in Europe.

ILLUSTRATION: Sow. Brit. Fungi *pl. 373, f. 7*.

6. **Lasiosphaeria multiseptata** Earle sp. nov.

Perithecia as in *Lasiosphaeria hispida;* spores long vermiform, slender, at first with numerous oil-drops, later becoming (many-

septate?), occasionally with one end of the spore enlarged forming a conspicuous head, 60–70 × 3–4 μ (*pl. 2, f. 8–9*).

Type collected on rotten wood of *Hicoria* at Tuskegee, Alabama, July 29, 1897, G. W. Carver *313* (herb. N. Y. Bot. Garden).

DISTRIBUTION: Alabama and Carolina.

EXSICCATI: Rav. Fungi Car. Exsicc. **5**: *66* (as *Sphaeria Rhacodium*).

The material from which the above species is described was labeled "sp. nov." in the herbarium of the New York Botanical Garden, and while closely related to *Lasiosphaeria hispida* seems to differ in the more slender spores which are multiguttulate and finally (many-septate ?) with the upper end occasionally enlarged into a conspicuous head.

In looking over the specimens under the name of *Lasiosphaeria hispida* several were found which agree with the one described here. Whether the enlargement of the end of the spore is a variable character as has already been noted in *Lasiosphaeria mucida,* I am unable to determine, but it is possible that this may be found to be the case.

7. **Lasiosphaeria globularis** (Batsch)

Sphaeria globularis Batsch, Elench. Fung. Cont. **1**: 271. 1786.

Sphaeria spermoides Hoffm. Veg. Crypt. **2**: 12. 1790.

Lasiosphaeria spermoides Ces. & De-Not. Comm. Soc. Crit. Ital. **1**: 229. 1863.

Leptospora spermoides Fuckel, Symb. Myc. 143. 1869.

? *Hypoxylon miliaceum* Bull. Herb. Fr. *pl. 444*.

Perithecia sessile, usually thickly crowded forming a compact mass somewhat resembling a *Hypoxylon,* often several cm. in diameter, at first cylindric, becoming subglobose, often so closely crowded as to become irregular in form from mutual pressure, black, 1 mm. high and .5 to 1 mm. in diameter, ostiolum only slightly prominent, slightly hairy becoming naked with age and minutely rough, very hard and carbonaceous; asci cylindric, 8-spored; spores cylindric, slightly curved, 20–27 × 4 μ, hyaline (*pl. 1, f. 16–18*).

On old wood.

TYPE LOCALITY: Germany.

DISTRIBUTION: Newfoundland to New York.

ILLUSTRATIONS: Batsch, Elench. Fung. l. c. *pl. 30, f. 180;* Rabenh. Krypt. Fl. 1^2: 195, *f. 1–3;* Engler-Prantl, Nat. Pfl. 1^1: 397, *f. 256*, A–B.

8. **Lasiosphaeria jamaicensis** sp. nov.

Perithecia thickly gregarious, depressed, subconic, flattened below so as to appear to be partially immersed in the substratum but in reality entirely superficial, when removed leaving a ring-like scar 1 mm. across, the diameter of the base of the perithecium, ostiolum large, circular and rather prominent, the entire perithecium covered with a brownish floccose coat or entirely black, sparingly clothed with delicate erect bristles which also occur on the substratum surrounding the perithecia; hairs very dark brown or blackish, septate, rather blunt, 10–12 μ in diameter at the base; asci clavate, 8-spored; spores vermiform with blunt ends, abruptly bent near the center, 8-guttulate, becoming 7-septate, subhyaline or slightly yellowish, 50–60 $\times$ 7 μ; paraphyses numerous and filiform (*pl. 1, f. 1–3*).

Type collected on the stem of some unknown plant (probably a palm) at Castle Gardens, Jamaica, December 14–15, 1908, by W. A. and Edna L. Murrill, *127* (herb. N. Y. Bot. Garden).

DISTRIBUTION: West Indies.

9. LASIOSPHAERIA NEWFIELDIANA Ellis & Ev. N. Am. Pyrenom. 150. 1892

?*Lasiosphaeria ambigua* Sacc. Michelia 1: 46. 1879.

Perithecia gregarious, superficial, at first depressed, becoming ovoid or subconic, about .5 mm. broad and as large as 1 mm. in height, clothed with soft brown hairs and seated on a dense brown mycelial growth consisting of the same kind of hairs; hairs brown, septate, about 4 μ in diameter; asci cylindric, 8-spored; spores vermiform, at first hyaline, 35 $\times$ 4 μ, with a short apiculus at each end, the upper end finally enlarged into an ellipsoid, brown head; at maturity the spore consisting of the brown head 15–17 $\times$ 6–7 μ with a cylindric hyaline appendage 3 $\times$ 20 μ at the base, and a slightly shorter, much more slender appendage, 1–2 μ in diameter at the apex (*pl. 1, f. 12–15*).

On rotten wood.

TYPE LOCALITY: Newfield, New Jersey.

DISTRIBUTION: New Jersey to Ohio.

10. LASIOSPHAERIA DICHROÖSPORA Ellis & Ev. Erythea 1: 197. 1893

Perithecia densely gregarious, ovoid, rugose, black, tough-membranaceous, clothed with a few slender brown hairs; ostiolum broad convex-papilliform, sometimes subcompressed; asci lanceolate, $150 \times 8\text{-}10\,\mu$, 8-spored; spores 2-seriate, cylindric, bent near the lower end and hyaline below for about one third the length of the spore, abruptly black above, each end mucronately pointed, about $40\text{–}60 \times 4\text{–}6\,\mu$ (*pl. 2, f. 13–15*).

On clay loam in woods.

TYPE LOCALITY: Seattle, Washington.

DISTRIBUTION: Known only from the type locality.

EXCLUDED SPECIES

Lasiosphaeria striata Ellis & Ev. Proc. Acad. Nat. Sci. Phil. 1893: 443. This species was described from material collected on willow limbs near Park Hill, Ontario, Canada, May 1893 by J. Dearness. The plant is a discomycete belonging to the genus *Godronia* and is apparently identical with *Godronia Betheli* Seaver which was described from material collected on branches of willow in the Rocky Mountains of Colorado. The small cups are constricted at their mouths and when dry collapse so as to give the appearance of perithecia which probably accounts for the fact that they were placed in the genus *Lasiosphaeria* by Ellis. The species would then be *Godronia striata* (Ellis & Ev.) Seaver with *Godronia Betheli* Seaver as a synonym.

EXPLANATION OF PLATE LXVI

Spores and asci drawn with camera lucida to a common scale.

Figs. 1–3. *Lasiosphaeria jamaicensis* Seaver. 1. Perithecia about natural size. 2. Perithecia enlarged. 3. Ascus and spores.

Figs. 4–7. *Lasiosphaeria strigosa* (Albert. & Schw.) Sacc. 4. Perithecia about natural size. 5. Perithecia enlarged. 6. Ascus with spores.

Figs. 8–11. *Lasiosphaeria stuppea* Ellis & Ev. 8. Perithecia about natural size. 9. Perithecia enlarged. 10. Ascus with spores. 11. Hair from perithecium.

Figs. 12–15. *Lasiosphaeria newfieldiana* Ellis & Ev. 12. Perithecia about natural size. 13. Perithecia enlarged. 14. Ascus with immature spores. 15. Ascus with mature spores.

Figs. 16–18. *Lasiosphaeria globularis* (Batsch) Seaver. 16. Perithecia about natural size. 17. Perithecia enlarged. 18. Ascus with spores.

EXPLANATION OF PLATE LXVII

Spores and asci drawn with camera lucida to a common scale.

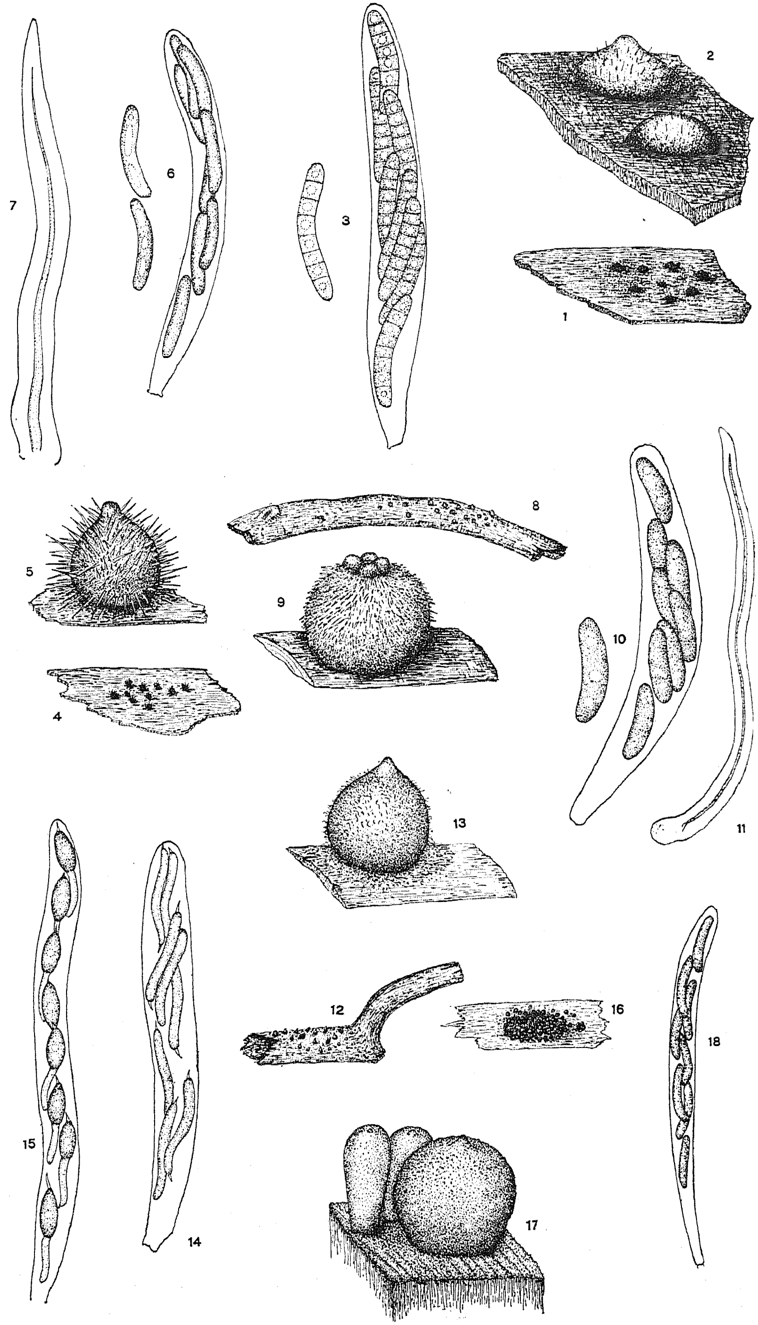
Figs. 1–7. *Lasiosphaeria hispida* (Tode) Fuckel. 1. Perithecia about natural size. 2. Hair from base of perithecium. 3 and 4. Perithecia enlarged. 5. Ascus with spores. 6. Spore showing septa. 7. Hairs from perithecia.

Figs. 8–9. *Lasiosphaeria multiseptata* Earle. 8. Ascus with spores. 9. Spores showing enlarged head.

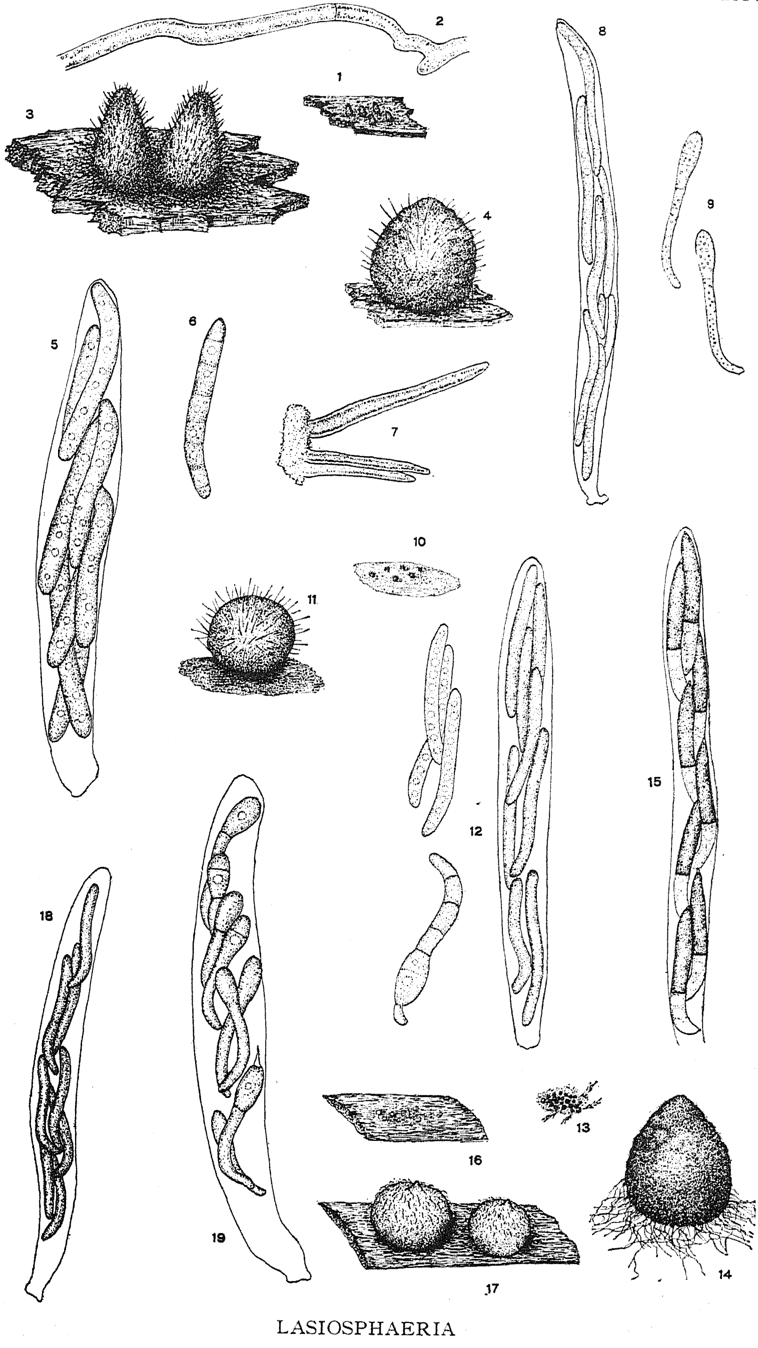
Figs. 10–12. *Lasiosphaeria terrestris* (Sow.) deThüm. 10. Perithecia about natural size. 11. Perithecia enlarged. 12. Ascus with spores.

Figs. 13–15. *Lasiosphaeria dichroöspora* Ellis & Ev. 13. Perithecia about natural size. 14. Perithecia enlarged. 15. Ascus with spores.

Figs. 16–19. *Lasiosphaeria mucida* (Tode) Seaver. 16. Perithecia about natural size. 17. Perithecia enlarged. 18. Ascus with immature spores. 19. Ascus with spores showing enlarged heads.



LASIOSPHAERIA



LASIOSPHAERIA

AN ENUMERATION OF LICHENS COLLECTED BY CLARA EATON CUMMINGS IN JAMAICA—I

LINCOLN W. RIDDLE

The lichens forming the basis of the following enumeration were collected by the late Professor Clara Eaton Cummings, of Wellesley College, on a trip to the island of Jamaica in the West Indies during February and March, 1905. After Professor Cummings' death, the collection was sent according to her instructions to the New York Botanical Garden. It is through the courtesy of Dr. and Mrs. N. L. Britton that I have been permitted to study the material.

The present paper contains the lichens of the groups Coniocarpineae, Cyclocarpineae, and Hymenolichenes. The Graphidineae are now being studied by Professor Bruce Fink, and these together with the Pyrenocarpeae will be treated in a subsequent paper.

It is unfortunate that the exact data relating to the locality and habitat of the specimens collected were lost after Professor Cummings' death, and it is, therefore, possible to give only the numbers attached to the specimens. Material of several of the numbers has been issued during the last two years in Mr. G. K. Merrill's Lichenes Exsiccati. All such will be referred to in connection with the respective species.

The study of the lichen flora of tropical America is attended with considerable difficulty, owing chiefly to two facts: first, in the case of many of the species there are no authentic specimens in American herbaria; and, second, the literature, while considerable in amount, is widely scattered and for the most part not correlated. In addition to Tuckerman's Synopsis of the North American Lichens, the most useful single work is Wainio's Étude sur les lichens du Bresil (in Acta Soc. Fauna et Flora Fennica. 1890). This is cited in the following enumeration as Wainio

1890. All other citations are given with sufficient completeness to be self-explanatory.

I am indebted to the courtesy of Professor W. G. Farlow for permission to consult the collections in the Cryptogamic Herbarium of Harvard University. Three collections therein contained have been of special help: Wright's Lichenes Cubae, determined by Tuckerman; Lindig's New Granada (Colombia) collections, determined by Nylander; and Wainio's Lichenes Brasiliensis Exsiccati.

I have followed the classification and nomenclature of Dr. Zahlbruckner's treatment of the lichens in Engler and Prantl's Die Naturlichen Pflanzenfamilien, Teil 1, Abteilung 1*; except that I have maintained *Biatora* as a genus distinct from *Lecidea,* and *Bilimbia* as distinct from *Bacidia,* and I have retained *Anaptychia* as a section of the genus *Physcia.*

CONIOCARPINEAE

SPHAEROPHORUS COMPRESSUS Ach. Meth. 135. 1803. Cummings no. 167.

CYCLOCARPINEAE

1. PILOCARPON TRICHOLOMA (Mont.) Wainio (1890) **2**: 89. *Biatora* Mont. Ann. Sci. Nat. III. **16**: 53. 1851. *Lecidea leucoblephara* Nyl. Ann. Sci. Nat. IV. **19**: 337. 1863 is considered by Tuckerman to be the same, and the description offers no sufficient characters to distinguish the two. Cummings nos. 175 and 187.

2. OCELLULARIA ACTINOTUM (Tuck.) Muell. Arg. Flora **70**: 397. 1887. *Thelotrema* Tuck. Proc. Am. Acad. Arts and Sci. **5**: 411. 1862. Cummings no. 107.

3. ?**Ocellularia anamorphum** (Nyl.) comb. nov. *Thelotrema* Nyl. Ann. Sci. Nat. IV. **19**: 329. 1863. Cummings no. 131 appears to belong here, but there has been no material available for comparison, and the descriptions are incomplete.

4. OCELLULARIA AUBERIANOIDES (Nyl.) Muell. Arg. Nuov. Giorn. Bot. Ital. **23**: 395. 1891. Cummings nos. 98 and 102.

5. OCELLULARIA CLANDESTINA (Ach.) Muell. Arg. Graph. Féean. in Mem. Soc. phys. et d'hist. nat. de Genève, vol. 29, no. 8, p. 7. 1887. Cummings nos. 94 and 96.

6. OCELLULARIA TEREBRATA (Ach.) Muell. Arg. loc. cit. Cummings no. 104.

7. THELOTREMA CONCRETUM Fée, Essai Suppl. 90. 1837. Cummings no. 100.

8. DIPLOSCHISTES SCRUPOSUS (L.) Norm. Con. Praem. Gen. in Nyt Magazin for Naturvidensk. 7: 232. 1853. *Urceolaria* Ach. Cummings no. 139.

9. MICROPHIALE LUTEA (Dicks.) Steiner, Sitzungsber. kais. Akad. Wiss. Wien **106**: 227. 1897. *Gyalecta* Tuck. Cummings no. 139.

10. GYALECTA GLOEOCAPSA (Nitschke) Zahlbr. in Engler & Prantl: Nat. Pflanzenfam. Teil 1, Abt. 1*, p. 126. 1905. *Bryophagus Gloeocapsa* Nitschke in Rabenhorst's Lich. Europ. no. 608. 1861. Cummings no. 85. This agrees exactly with some of the original material, and is of interest in being, so far as I am aware, the only record of the species outside of central Europe.

11. COENOGONIUM LEPRIEURII (Mont.) Nyl. Ann. Sci. Nat. IV. **16**: 89. 1861. Cummings no. 170.

12. **Biatora aurigera** (Fée) comb. nov. *Lecidea* Fée Essai Crypt. 106. 1824. Cummings no. 132. The specimens agree with the descriptions, but there has been no material available for comparison.

13. BIATORA COARCTATA (Smith) Tuck. Syn. N. A. L. **2**: 15. 1888. Cummings no. 115.

14. **Biatora amorphocarpa** sp. nov.

Thallus white, farinose, made up of more or less heaped and conglomerate granules, effused and indeterminate. Apothecia 0.3–0.7 mm. in diameter, at first plane, disk dark ferruginous-brown, with a thick paler brown margin, then becoming tuberculose-proliferate and difform, and somewhat paler. Exciple ferruginous, epithecium olivaceous, granulate, thick (10 μ); paraphyses sparingly branched above, with clavate tips; hymenium pale, 50 μ

high, becoming blue with iodine; hypothecium pale, KOH. Spores 8, fusiform, with rounded ends, more or less guttulate (rarely faintly uniseptate), hyaline, 13–15 × 3 μ.

Type collected on bark, Jamaica, B. W. I. Clara E. Cummings nos. 135 and 140, in the herbarium of Wellesley College.

15. **Biatora endocaerulea** sp. nov.

Thallus scanty, of scattered and irregularly heaped, discrete, minute, crystalloid granules. Apothecia minute, under 0.5 mm. in diameter, elevated, always emarginate, at first regularly subglobular, then proliferous and forming irregular gibbous masses, reaching about 1 mm. in diameter. In section the entire apothecium, including hymenium and hypothecium is a beautiful deep indigo blue, turning clear green with KOH. Spores 8, hyaline, simple, or rarely faintly uniseptate, narrow-oblong, 8–10 × 3.5 μ.

Type collected on bark, Jamaica, B. W. I. Clara E. Cummings no. 161, in the herbarium of Wellesley College.

16. **Biatora lanuginosa** sp. nov.

Thallus white, byssine, thick and felt-like, made up of loose, irregularly branching hyphae, 4–7 μ in diameter, with minutely roughened walls, surrounding green, Pleurococcus-like gonidia. Apothecia 0.5–1.5 mm. in diameter, disk dark brown, at first concave with a thick, minutely pubescent, pale margin, which shows a pinkish tinge, then becoming plane and strongly flexuous, and the margin thin. Epithecium and hymenium hyaline; exciple of radiating hyphae pale ferruginous; body of apothecium pseudoparenchymatous, darker ferruginous; hypothecium deep ferruginous-brown to brownish-black. Spores 8, hyaline, simple, oblong, 8–12 × 3.5–4 μ. Hymenium greenish-blue with iodine.

Type collected on the ground over matted roots, Jamaica, B. W. I. Clara E. Cummings no. 121, in the herbarium of Wellesley College.

17. BIATORA ONCODES Tuck. Syn. N. A. L. **2**: 157. 1888. *Lecidea* Tuck. Proc. Am. Acad. Arts and Sci. **6**: 274. 1864. Cummings no. 119.

18. **Catillaria leptocheila** (Tuck.) comb. nov. *Lecidea* Tuck. in Proc. Am. Acad. Arts and Sci. **6**: 280. 1864. *Heterothecium* Tuck. Syn. N. A. L. **2**: 55. 1888. Cummings no. 149.

19. **Catillaria rosea** sp. nov.

Thallus thin to medium, creamy-fuscescent, verruculose-

uneven. Apothecia 0.8–1.5 mm. in diameter, scattered, somewhat elevated, convex to globular, in part irregular to subdifform, always emarginate. In section the entire apothecium below the hymenium is brownish-black, becoming a beautiful rose-red with KOH; epithecium fuliginous; hymenium pale, becoming greenish-blue with iodine. Spores 8, hyaline, narrow-ellipsoid, somewhat larger at one end, bilocular, 10–13 $\times$ 4–5 μ.

Type collected on bark, Jamaica, B. W. I. Clara E. Cummings no. 127, in the herbarium of Wellesley College.

20. **Megalospora Cummingsiae** sp. nov.

Thallus sulphur-color, thick and irregular, coarsely verrucose-granulose to finely mealy. Apothecia ample, 2–3 mm. in diameter, dark rufous-brown, with a thick, entire, concolorous and persistent margin. Epithecium and exciple deep brown; hymenium white, opaque, 250 μ high, without reaction with iodine; hypothecium thin, white, subtended by a brownish-black layer. Spores solitary or 2, thick-walled, curved, 72–110 $\times$ 20–26 μ. Distinct from *M. sulphurata* Mey. & Flot. in the partly mealy thallus, the large spores, and the absence of reaction of the hymenium with iodine.

Type collected on bark, Jamaica, B. W. I. Clara E. Cummings no. 129, in the herbarium of Wellesley College. I take pleasure in naming this new species after its discoverer, in recognition of her services to North American lichenology.

21. **Megalospora jamaicensis** sp. nov.

Thallus stramineous, thin, continuous, smooth and shining. Apothecia 1–1.5 mm. in diameter, elevated, disk pale brown, with a thick, stramineous margin, which is entire when young, becoming crenate with age. Exciple pale yellow, epithecium and hypothecium hyaline. Spores solitary (or 2), hyaline, bilocular, thick-walled, straight or slightly curved, 72 $\times$ 20 μ. Distinct from *M. sulphurata* Mey. & Flot. in the color of the apothecia and the straighter spores.

Type collected on bark, Jamaica, B. W. I. Clara E. Cummings nos. 138 and 142, in the herbarium of Wellesley College.

22. MEGALOSPORA VERSICOLOR (Fée) Zahlbr. in Engler & Prantl Nat. Pflanzenfam. Teil 1, Abt. 1*, p. 134. 1905. *Lecidea* Fée. *Heterothecium* Flot. Cummings nos. 151 and 153.

23. **Bilimbia artytoides** (Nyl.) comb. nov. *Lecidea* Nyl. Ann. Sci. Nat. IV. **19**: 342. 1863. *Biatora triseptata* var. *artytoides* Tuck. Genera Lich. 162 (note). 1872. Cummings no. 166.

24. BILIMBIA HYPNOPHILA (Ach.) Th. Fr. Lich. Arctoi 183. 1860. Cummings no. 166*a*.

25. **Bilimbia pallidissima** sp. nov.

Thallus dirty white, thin, of more or less discrete, flattened, minute granules. Apothecia minute, 0.2–0.5 mm. in diameter, closely appressed and flattened, emarginate from the beginning, soon irregular and confluent, very pallid. In section the apothecium is entirely hyaline in all parts. Spores 8, hyaline, 4-locular, fusiform, blunt, broader at one end, 17–20 × 4–5 μ.

Type collected on bark, Jamaica, B. W. I. Clara E. Cummings no. 134, in herbarium of Wellesley College. Stock of *B. sphaeroides* (Dicks.) Th. Fr., from which it differs in the thallus and in the shape of the apothecia.

26. **Bilimbia radicicola** sp. nov.

Thallus pale creamy-brown, thick, encrusting the substratum, finely but densely granular. Apothecia 0.6–1 mm. in diameter, dark ferruginous-brown, at first somewhat concave, with a thick, flexuous paler margin, then becoming plane to convex and the margin less prominent, although always persistent. Exciple and epithecium pale; hymenium tinged with brown; hypothecium brownish-black. Spores 8, hyaline, 4-locular, oblong-ovoid to broad fusiform, larger at one end, 22–30 × 8–10 μ.

Type found growing over matted roots, Jamaica, B. W. I. Clara E. Cummings no. 162, in the herbarium of Wellesley College. Apparently related to *B. molybditis* (Tuck.).

27. **Bilimbia thysanota** (Tuck.) comb. nov. *Lecidea* Tuck. Proc. Am. Acad. Arts and Sci. **6**: 277. 1864. *Biatora* Tuck. Syn. N. A. L. **2**: 158. 1888. Cummings no. 150.

28. **Bilimbia terrestris** sp. nov.

Thallus dirty white, of heaped and conglomerate granules, which average 0.2 mm. in diameter, the heaps scattered and not forming a continuous thallus. Apothecia 0.8–1 mm. in diameter, subimmersed, solitary or aggregated, convex to globular, emar-

ginate, ferruginous-brown to almost black. Epithecium pale greenish; hypothecium pale; paraphyses filiform, sparingly branched above, hymenium hyaline, becoming blue with iodine. Spores 8, hyaline, 4-locular, fusiform-oblong with rounded ends, $17–22 \times 6–9\,\mu$.

Type collected on earth, Jamaica, B. W. I. Clara E. Cummings no. 164, in herbarium of Wellesley College. In habit, this species resembles *B. artytoides* (Nyl.), but it is distinct in the discrete granules of the thallus, in the convex and emarginate apothecia, and in the pale hypothecium.

29. BACIDIA ENDOLEUCA (Nyl.) Kicks. Fl. Crypt. Fland. **1**: 261. 1867. *Biatora atrogrisea* (Delise) Hepp. Cummings no. 148.

30. BACIDIA RUBELLA (Hoffm.) Mass. Ric. sull. auton. Lich. 118. 1852. *Biatora* Rabenh. Cummings no. 124.

31. **Bacidia subgranulosa** (Tuck.) comb. nov. *Lecidea microphyllina* var. *subgranulosa* Tuck. Proc. Am. Acad. Arts and Sci. **6**: 278. 1864. *Biatora subgranulosa* Tuck. Syn. N. A. L. **2**: 40. 1888. Cummings no. 118.

32. **Toninia janeirense** (Muell. Arg.) comb. nov. *Thalloidima* Muell. Arg. Hedwigia **31**: 280. 1892. Cummings no. 48. The specimens agree exactly with the description, but there has been no material available for comparison.

33. BOMBYLIOSPORA TUBERCULOSA (Fée) Mass. Ricerch. sull. auton. Lich. 116. 1852. *Heterothecium* Flot. Cummings no. 145.

34. **Lopadium amaurum** (Wainio) comb. nov. *Lecidea* Wainio in Journ. of Bot. **34**: 103. 1896. Cummings no. 152.

35. LOPADIUM LEUCOXANTHUM (Spreng.) Zahlbr. Sitzungsber. kais. Akad. Wiss. Wien **111**: 398. 1902. *Heterothecium* Mass. Cummings no. 146.

36. PHYLLOPSORA FURFURACEA (Pers.) Zahlbr. in Engler & Prantl Nat. Pflanzenfam. Teil 1, Abt. 1*, p. 138. 1905. *Lecidea* Pers. and many authors. *Biatora* Tuck. Cummings nos. 49 and 137.

37. PHYLLOPSORA PARVIFOLIA (Pers.) Muell. Arg. Bull. Herb. Boiss. vol. 2, append. 1, p. 90. 1894. *Biatora* Tuck. Cummings no. 44.

38. BAEOMYCES ABSOLUTUS Tuck. Amer. Journ. Sci. 28: 201. 1859. Cummings no. 176.

39. BAEOMYCES ERYTHRELLUS (Mont.) Nyl. Syn. 1: 181. 1858. Cummings nos. 177 and 178. No. 114 is sterile and has the stipes fastigiately branched, but it clearly belongs here also.

(*Note.*—As the full bibliographical citations for the species of *Cladonia* are given in Wainio's well-known "Monographia Cladoniarum Universalis," it has seemed unnecessary to give them here.)

40. CLADONIA AGGREGATA (Sw.) Ach. No. 73.

41. CLADONIA ALPESTRIS (L.) Rabenh. No. 83.

42. CLADONIA ANGUSTATA Nyl. No. 70. Issued in Merrill's Lich, Exsic. no. 63, as *C. Floerkeana f. intermedia* Hepp, but a comparison of the material with an authentic specimen of *C. angustata* in the Tuckerman herbarium shows it to be that species.

43. CLADONIA CERATOPHYLLA (Sw.) Spreng. No. 69.

44. CLADONIA DACTYLOTA Tuck. No. 71.

45. CLADONIA DEGENERANS (Flke.) Spreng. No. 79. This is a reduced form, but agrees well with some of the smaller specimens in the Tuckerman herbarium.

46. CLADONIA DIDYMA var. MUSCIGENA (Eschw.) Wainio. No. 72.

47. CLADONIA FIMBRIATA var. SIMPLEX (Weis.) Flot. No. 75.

48. CLADONIA FIMBRIATA var. SUBULATA (L.) Wainio. No. 74.

49. CLADONIA PITYREA (Flke.) Fr. Nos. 77 and 78. No. 76 also appears to belong here, although it is less typical.

50. CLADONIA RANGIFORMIS Hoffm. No. 81.

51. CLADONIA SYLVATICA (L.) Hoffm. No. 82.

52. STEREOCAULON CORNUTUM Muell. Arg. Flora 69: 252. 1886. Cummings no. 11. Issued in Merrill's Lich. Exsic. no. 121 as *S. pityrizans* Nyl. Whether or not these two names are synonyms is a point that can be settled only by a study of the type specimens.

53. STEREOCAULON RAMULOSUM (Sw.) Ach. Meth. 314. 1803. Cummings nos. 9, 10, and 12 may all be placed here provisionally, awaiting the completion of a monographic revision of the genus now in progress.

54. DICHODIUM BYRSINUM (Ach.) Nyl. Lich. Nov. Zeland. 9. 1888. *Physma byrsaeum* (Afzel.) Tuck. Syn. N. A. L. 1: 115. 1882. Cummings no. 45.

55. LEPTOGIUM BULLATUM (Ach.) Nyl. Syn. 1: 129. 1858. Cummings no. 56.

56. LEPTOGIUM CHLOROMELUM (Sw.) Nyl. Syn. 1: 128. 1858. Cummings no. 67. This is scarcely typical, but agrees with some of the material so named in the Tuckerman herbarium.

57. LEPTOGIUM MARGINELLUM (Sw.) Mont. apud Ramon de la Sagra: Hist. physique Cuba 1: 115. 1838–1842. Cummings no. 68. Issued in Merrill's Lich. Exsic. no. 86.

58. LEPTOGIUM LACERUM (Sw.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 401. 1821. Cummings no. 60. This is sterile but agrees with material in the Tuckerman herbarium.

59. LEPTOGIUM PHYLLOCARPUM (Pers.) Nyl. Syn. 1: 130. 1858. Cummings no. 59.

60. LEPTOGIUM PUNCTULATUM Nyl. Lich. Mexican. 1. 1872. Cummings no. 64. This has been compared with the material so named in Wainio's Lich. Brasil. Exsic. no. 380, from which it differs only in the thallus being more lacerate. But the spores are considerably larger than the measurements given by Wainio, being $33 \times 10\,\mu$ instead of a maximum of $28 \times 5\,\mu$, and the material may prove to be distinct.

61. LEPTOGIUM SATURNINUM (Dicks.) Nyl. Actes Soc. Linn. Bordeaux **21**: 272. 1856. *Leptogium myochroum* var. *tomentosum* (Hoffm.) Schaer. Cummings nos. 57 and 58.

62. LEPTOGIUM TREMELLOIDES (L. f.) S. F. Gray, Nat. Arr. Brit. Pl. **1**: 400. 1821. Cummings nos. 63 and 66; also 65 (?).

63. LEPTOGIUM TREMELLOIDES f. IMPRESSO-PUNCTATUM Tuck. in Wright's Lich. Cubae no. 17. Cummings no. 61. Issued in Merrill's Lich. Exsic. no. 131 as *L. foveolatum* Nyl. a species much more definitely lacunose than the present form, which is minutely and sparsely pitted.

64. PARMELIELLA TRYPTOPHYLLA (Ach.) Muell. Arg. Mem. Soc. phys. et d'hist. nat. de Genève **16**: 376. 1862. *Pannaria* Mass. Cummings no. 50.

65. PANNARIA LEUCOSTICTA Tuck. Proc. Am. Acad. Arts and Sci. **4**: 404. 1860. Cummings no. 47*a*.

66. PANNARIA RUBIGINOSA (Thunb.) Delise. Dict. Class. **13**: 20. 1828. Cummings no. 46. No. 47 also appears to belong here but is less typical.

67. **Erioderma microcarpa** sp. nov.

Thallus irregularly and more or less imbricately laciniate-lobate; upper surface fuliginous-brown, coarsely short-pilose, minutely but conspicuously roughened between the fibrils; under side sulphury to intensely yellow, conspicuously veined, and with white rhizoids. Upper cortex well-developed and pseudoparenchymatous. Apothecia very small for the genus, 0.8 mm. or less in diameter, pallid reddish-brown, borne on the surface of the thallus and somewhat elevated, margin concolorous, thick and subpersistent, glabrous. Exciple well-developed, of vertical, parallel, thick-walled hyphae, pallid, without gonidia, epithecium obscure, granular; hymenium hyaline, with iodine blue, slowly turning brown; hypothecium pallid. Spores 8, simple, hyaline, ovoid, the epispore thickened and minutely roughened, $12–16 \times 7–8\,\mu$.

Type collected in Jamaica, B. W. I. Clara E. Cummings no. 189, in herbarium of Wellesley College.

68. ERIODERMA WRIGHTII Tuck. Am. Journ. Sci. **25**: 423. 1858. Cummings no. 25.

69. ERIODERMA sp. Cummings no. 42 evidently belongs to this genus and to a different species from either of those given above, but it is sterile and too immature for certain determination.

70. COCCOCARPIA PELLITA (Ach.) Muell. Arg. Flora **65**: 320. 1882. *Pannaria molybdea* (Pers.) Tuck. Gen. Lich. 52. 1872. Cummings no. 143; also no. 160, which approaches var. *cronia* (Tuck.) Muell. Issued in Merrill's Lich. Exsic. no. 114.

(*Note.*—The tropical species of *Lobaria* and *Sticta* are much in need of monographic revision. In the absence of such a treatment I can do no more than give the results of a careful comparison of the specimens with the material in the Tuckerman herbarium.)

71. LOBARIA CORROSA (Ach.) Wainio (1890) **1**: 200. *Sticta dissecta* var. *corrosa* (Ach.) Tuck. Syn. N. A. L. **1**: 93. 1882. Cummings no. 21. Issued in Merrill's Lich. Exsic. no. 42.

72. **Lobaria pallida** (Hook.) comb. nov. *Sticta* Hook. in Kunth: Syn. plant. quas in itin. ad plag. aequinoct. orb. novi colleg. Humboldt & Bonpland **1**: 29. 1822. Cummings no. 23.

73. LOBARIA PELTIGERA (Delise) Wainio (1890) **1**: 199. *Sticta dissecta* Ach. and many authors. The material bearing this name in the Tuckerman herbarium varies very greatly, and it seems scarcely possible that it can all be one species.

(*a*) Cummings no. 24 is the smooth, polished form with very regular and beautiful sinuate lobing. It agrees best with the specimen in Wainio's Lich. Brasil. Exsic. no. 378. It also agrees with the type specimens of *Sticta Fendleri* Mont. & Tuck., which Tuckerman seems to have considered to be a synonym.

(*b*) Cummings no. 20 is an even, dull form with short rather irregular lobes. It agrees with material from Jamaica collected by J. Hart.

(*c*) Cummings no. 18 is the minutely pitted form with

narrower, somewhat irregular lobes, which agrees with many of the specimens in the Tuckerman herbarium. From the descriptions, one would consider this to be the *Ricasolia subdissecta* of Nylander (Ann. Sci. Nat. IV. **11**: 214. 1859), but material under the latter name in the Tuckerman herbarium does not agree. It is to be noted, also, that Delise in the original description of *Sticta peltigera* (Histoire du genre Sticta, 150. 1822) says "supra lacunoso." Material corresponding to no. 18 was issued in Merrill's Lich. Exsic. no. 41.

74. LOBARIA EROSA (Eschw.) Forssell, Bihang till k. Svenska Vet. Akad. Handlingar **8**: 24. 1883. *Sticta erosa* Tuck. Syn. N. A. L. **1**: 93. 1882. *Lobaria quercizans* Wainio (1890) **1**: 195, not Michx. Fl. Bor. Am. **2**: 324. 1803. Concerning the correct name to be used for this species, compare Hue in Nouv. Arch. Mus. d'Hist. Nat. Paris, IV. **3**: 34. 1901. Cummings nos. 19 and 22.

75. STICTA AURATA (Sm.) Ach. Meth. 277. 1803. Cummings nos. 26 and 27. Issued in Merrill's Lich. Exsic. no. 44.

76. STICTA CROCATA (L.) Ach. Meth. 277. 1803. Cummings no. 26*a* is paler than usual and approaches *S. Mougeotiana* Delise, an authentic specimen of which is in the Tuckerman herbarium.

77. STICTA CROCATA var. LEUCOSTICTA (Pers.) Nyl. Ann. Sci. Nat. IV. **11**: 238. 1859. Cummings no. 31.

78. STICTA DAMAECORNIS (Sw.) Ach. Meth. 276. 1803.

(*a*) No. 37 is the typical form.

(*b*) No. 30 is a more narrowed, and distinctly dichotomous form, agreeing well with *f. elongato-laciniata* Tuck. in Wright Lich. Cubae no. 60.

(*c*) No. 28 differs from no. 30 only in being narrower still (2 mm. wide or less) and the margins incurved so as to make the lobes subtubular.

79. STICTA DAMAECORNIS var. SINUOSA (Pers.) Nyl. Syn. **1**: 356. 1858. Cummings no. 36.

80. STICTA TOMENTOSA (Sw.) Ach. Meth. 279. 1803. Cummings no. 29 has cilia longer than usual and margins with occasional lobules, which are, however, not at all isidioid, as in *S. Weigelii* (Ach.) Wainio. No. 33 also comes here but has glabrous margins.

81. STICTA WEIGELII (Ach.) Wainio (1890) **1**: 189. *Sticta quercizans* Delise Hist. Sticta 84. 1822, and many authors. Cummings nos. 32, 34 and 35.

82. PELTIGERA CANINA (L.) Hoffm. Deutsch. Fl. **2**: 106. 1795. Cummings no. 51 is the typical form. No. 52 has been issued in Merrill's Lich. Exsic. no. 49 as "var. laciniata Merrill var. nov." This appears to be worthy of varietal rank and as the above is a *nomen nudum* a brief diagnosis is here appended: Thallus deeply cleft into relatively few, narrow lobes (1 cm. wide or less), with the margins more or less crenate and crisped; upper surface conspicuously tomentose; under side pale at the margin, becoming dark toward the center, with a few scattered, coarse rhizoids.

83. PELTIGERA POLYDACTYLA (Neck.) Hoffm. loc. cit. Cummings nos 53 and 54.

84. PERTUSARIA CRYPTOCARPA Nyl. Ann. Sci. Nat. IV. **11**: 221. 1859. Cummings no. 106 agrees with Nylander's description, except that the spores are somewhat larger ($96–125 \times 30–36\,\mu$ instead of $80–95 \times 28–30\,\mu$).

85. PERTUSARIA LEIOPLACELLA Nyl. Bull. Soc. Linn. Normandie II. **2**: 71. 1868. Cummings no. 123.

86. PERTUSARIA TUBERCULIFERA Nyl. Ann. Sci. Nat. IV. **19**: 323. 1863. Cummings no. 103.

87. PERTUSARIA VELATA (Turn.) Nyl. Not. Sallsk. Faun. Flor. Fenn. **5**: 179. 1861. Cummings no. 101.

88. LECANORA PALLIDA (Schreb.) Schaer. Enum. Lich. Eu. 78. 1850. Cummings no. 120.

89. LECANORA SUBFUSCA (L.) Ach. Lich. Univ. 393. 1810. Cummings no. 113*a*.

90. LECANORA VARIA (Hoffm.) Ach. Lich. Univ. 377. 1810. Cummings nos. 113 and 130.

91. HAEMATOMMA PUNICEUM (Ach.) Wainio (1890) **1**: 72. *Lecanora* Ach. Syn. 174. 1814. Cummings no. 141.

92. PARMELIA CETRATA var. CILIOSA Viaud-Grand-Marais, Notes Parm. Phys. de l'Ouest 156. 1892. Cummings no. 38. Margins both sorediate and ciliate.

93. PARMELIA CETRATA var. SUBSIDIOSA Muell. Arg. Engler Jahrb. **20**: 256. 1894. Cummings no. 39. Margins isidiose and ciliate.

94. PARMELIA LAEVIGATA (Sm.) Ach. Syn. 212. 1814. Cummings nos. 17, 40 and 41.

95. PARMELIA PERFORATA (Wulf.) Ach. Meth. 217. 1803. Cummings no. 43 appears to belong here, but is scarcely typical, the rhizoids being almost wholly absent, and the margins with soredia as well as cilia.

96. PHYSCIDIA WRIGHTII Tuck. Proc. Am. Acad. Arts and Sci. **5**: 401. 1862. Cummings no. 125. This has been compared with the type specimens in Wright's Lich. Cubae no. 92 and agrees exactly. It is to be noted that Dr. Zahlbruckner in Engler & Prantl: Nat. Pflanzenfam. (loc. cit.) erroneously states that the spores of this genus are simple.

97. RAMALINA DENTICULATA (Eschw.) Nyl. Bull. Soc. Linn. Normandie II. **4**: 126. 1870. Cummings no. 179.

98. RAMALINA LINEARIS (Sw.) Ach. Lich. Univ. 598. 1810. Cummings nos. 180 and 181.

99. RAMALINA USNEOIDES (Ach.) Fr. Lich. Eu. 468. 1831. Cummings no. 188.

100. USNEA ANGULATA Ach. Syn. 307. 1814. Cummings no. 4 is a peculiar sorediate form; no. 5 is typical.

101. USNEA CERATINA Ach. Lich. Univ. 619. 1810. Cummings nos. 2 and 6.

102. USNEA DASYPOGA (Ach.) Nyl. apud Hue in Nouv. Arch. Mus. d'Hist. Nat. Paris III. 2: 270. 1890. Cummings nos. 7 and 8.

103. USNEA FLORIDA (L.) Web. in Wigg. Prim. Fl. Holsat. 91. 1780. Cummings no. 3.

104. USNEA LAEVIS (Eschw.) Nyl. Syn. 1: 271. 1858. Cummings no. 1. A part of the material is minutely white spotted, but it is not at all papillate. (*Usnea plicata* Ach. was issued in Merrill's Lich. Exsic. no. 109, but the species was not represented in the two sets which formed the basis of this enumeration.)

105. TELOSCHISTES FLAVICANS (Sw.) Norm. Con. Praem. Gen. in Nyt Magazin for Naturvidensk. 7: 229. 1853. Cummings nos. 167 and 169. Issued in Merrill's Lich. Exsic. no. 59.

106. **Buellia stipitata** sp. nov.

Thallus entirely endophloeodal. Apothecia elevated and substipitate, 0.8–1.6 mm. in diameter, brownish-black, at first concave, with a prominent, thick, concolorous margin, then becoming plane, the margin less prominent but persistent, and the apothecia more or less flexuous. Epithecium fuliginous; hymenium hyaline, with iodine, blue, quickly becoming vinous-red; hypothecium brownish-black, subtended by a thick, fuliginous, pseudoparenchymatous region. Spores 8, brown, broad fusiform, bilocular, rarely each cell biguttulate, $14–17 \times 5–7\ \mu$.

Type collected on bark, Jamaica, B. W. I. Clara E. Cummings no. 122, in herbarium of Wellesley College.

107. BUELLIA SUBDISCIFORMIS (Leight.) Wainio (1890) 1: 167. Cummings no. 147.

108. RINODINA CONRADI Koerb. Syst. Lich. Germ. 123. 1855. Cummings nos. 116 and 165.

109. RINODINA EXIGUA (Ach.) Th. Fr. Lich. Scand. 201. 1871. *R. sophodes* var. *exigua* Tuck. Syn. N. A. L. 1: 208. 1882. Cummings no. 126.

110. PYXINE PICTA (Sw.) Tuck. Syn. N. A. L. 1: 79. 1882. Cummings no. 112.

111. PHYSCIA COMOSA (Eschw.) Nyl. Syn. 1: 416. 1858. Cummings nos. 13 and 14.

112. PHYSCIA HYPOLEUCA (Ach.) Tuck. Syn. N. A. L. 1: 68. 1882. Cummings no. 16. This is typical, except that the ends of some of the lobes are sorediate.

113. PHYSCIA LEUCOMELA (L.) Michx. Fl. Bor. Am. 2: 326. 1803. Cummings no. 15. Issued in Merrill's Lich. Exsic. no. 22.

HYMENOLICHENES

CORA PAVONIA (Web.) Fr. Syst. Orb. Veg. 300. 1825. Cummings no. 168.

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NOTES ON SOME WESTERN UREDINEAE WHICH ATTACK FOREST TREES[1]

George Grant Hedgcock

The following paper is summarized from field notes on a number of heteroecious rusts on forest trees in the western United States.

1. Peridermium filamentosum Peck

This fungus is the cause of a very serious disease of the western yellow pine (*Pinus ponderosa* Laws.) in portions of Colorado, and probably in adjacent sections of New Mexico and Arizona. This fungus was first discovered by Pringle[2] in the Santa Rita Mountains in Arizona, July 13, 1881. Although very abundant in certain localities in Montezuma and San Juan National Forests in southern Colorado, it was first discovered in Montezuma National Forest by F. B. Notestein (F. P. 190) the latter part of June, 1910. This collection was the second recorded, a portion of which was sent to Dr. J. C. Arthur and identified by him. Mr. Notestein again collected it on June 26, 1911 (F. P. 1888). Since then the fungus was collected by the writer July 8, 1911, on Pikes Peak, Colorado, in Pike National Forest, in East San Juan National Forest, July 13, 1911, near Pagosa Springs, Colorado, and in the Montezuma National Forest July 19, 1911, near Nancos, Ariz., (F. P. 9085). Mr. Notestein reports it as occurring abundantly in various parts of Montezuma National Forest. A tree apparently diseased with the fungus was noted enroute near Telluride, Colorado, July 19, 1911.

This species of *Peridermium* attacks the twigs, limbs, and trunks of both young and old trees in the cambium, but producing little or no swelling of the parts affected. There is a tendency occasionally towards witches broom formation where side limbs

[1] Published by permission of the Secretary of Agriculture.

[2] Arthur, J. C., and Kern, F. D. North American species of *Peridermium*. Bull. Torrey Club 33: 418. 1906.

are attacked, such limbs usually being more pendant than normal ones, being slightly thickened and clustered, resembling slightly the limbs in the pendant witches brooms formed by the stimulation of the mistletoe, *Razoumofskya cryptopoda* (Eng.) Coville. The fungus apparently spreads through the cambium of twigs, often entering the new growth each year. The effect of the fungus on the growth of such twigs is in some instances to slightly increase the number of twigs produced, and to increase their diameter; but usually there is no swelling produced. In a number of older trees, 75 to 150 years old, the apparent effect of the fungus on the main limbs had been to cause cankered areas to form, and to kill the entire tops, producing spike-topped trees. Such trees finally die, probably from the effects of insects or fungi which follow the weakening effects of the *Peridermium*. A large number of trees have either been stunted or slowly killed by this fungus in the Montezuma National Forest. Judging from the age and condition of many of the affected trees, the fungus has been present in this region for many years.

On Pikes Peak, beneath the trees diseased with *Peridermium filamentosum* only one rust was found which could be associated with this fungus as a telial form. The leaves of *Castilleja integra* A. Gray were found diseased with the uredinia of *Cronartium coleopsorides* (Dietel & Holway) Arthur during the second week in July, 1911. In the forest near Mancos, Colo., a few sori with the telia of the same fungus was found on the same species of *Castilleja* near some western yellow pines diseased with *Peridermium filamentosum.*

Peridermium filamentosum[3] or a closely related species was also found by Dr. E. P. Meinecke and Mr. W. H. Long, in Lassen National Forest, September 16, 1911, on the limbs and twigs of *Pinus contorta* Loud. In the immediate vicinity, *Cronartium coleosporoides* was found on a species of *Castilleja,* furnishing additional proof of the possible relation of the latter species of fungus to *Peridermium.* Inoculations will be made to verify this assumption of relationship between *Peridermium filamentosum* and *Cronartium coleosporoides* the coming season.

[3] This specimen has since been identified by Mr. W. H. Long as *Peridermium stalactiforme* Arth. and Kern.

Peridermium filamentosum apparently has been held in limited areas for a long time by natural boundaries to certain forests, viz., the treeless region separating the mountain ranges in Colorado, New Mexico, and Arizona. The fungus should be made the subject of further investigation, and watched closely, since its effect on seedling trees is much like the dreaded *Cronartium ribicola* Fischer (*Peridermium strobi* Kleb.) in Europe. It certainly should not be allowed to invade any of the forest tree nurseries in the West, from which it might be disseminated over a much greater region than its present habitat, and as a result great damage be done to our magnificent western yellow pine and related species.

2. PERIDERMIUM HARKNESII Moore

This species of *Peridermium* is found attacking the following species of pines in our western forests: *Pinus contorta* Loud., *P. Jeffreyi* "Oreg. Com.," *P. ponderosa* Laws., *P. radiata* Don., and *P. sabiniana* Dougl. The range of the species is from Colorado northward to Montana, and westward to Washington, Oregon, and California. It is most common on the lodgepole pines in the forests of the Rocky Mountains.

Peridermium harknesii has an effect on pines almost identical with that of *Peridermium cerebrum* Peck on pines in eastern and central United States. Globose or oblong galls or burls, varying in diameter from a pea to more than a foot are formed, usually surrounding the twigs, limbs, and trunks at the point of attack. Rarely a witches broom formation of limbs or twigs just above the galls takes place. Young trees attacked are often killed by the interference of the galls with the growth beyond the point of attack. In such cases the galls apparently have a strangulating effect. The fungus persists in the cambium of the galls for many years, but as in case of *Peridermium cerebrum,* rarely fruits annually. Apparently the older the galls become, the less frequently the aecia are formed on the surface.

Repeated and careful inoculation with aeciospores of this *Peridermium* on the leaves of young oaks of a number of species failed to infect them, while at the same time, inoculations with *Peridermium cerebrum* Peck on the same species of oak trees

brought about an infection, resulting in the uredinia and telia of *Cronartium quercum* (Brond.) Arth.

In nature, there is constantly associated with *Peridermium harknesii* a species of *Coleosporium* on a number of species of *Aster*. This association was found so constantly this year, as to venture the prediction that the *Coleosporium* may be a telial form of this species of *Peridermium*. It is very evident that the telial form cannot be a *Cronartium* on oaks, since none are found in an immense region in the Northwest, where this fungus occurs on the pines. It occurs where there are no oaks within a thousand miles.

Peridermium harknesii, like *P. cerebrum*, kills many young pines, but is not to be considered as dangerous a species as *P. filamentosum* in its effects on older trees, because it does not have the ability like the latter to spread along the limbs from the point of infection, but remains confined to the galls it forms.

3. PERIDERMIUM MONTANUM Arth. & Kern

This species of *Peridermium* attacks the leaves of *Pinus contorta* Loud. in the Northwest, but is not so widely disseminated as *P. harknesii*. It exerts an injurious effect on the leaves at the time it forms its aecia, owing to the bursting of the epidermis of the leaves by the pustules of the fungus. The leaves lose water, and gradually die, in fact, live but a short time after the aecia mature. This causes a premature shedding of the leaves, so that where a lodgepole pine, if healthy, would bear 5 to 7 years' foliage, trees after being attacked by an epidemic of this *Peridermium* usually bear only 2 to 3 years' growth of needles, all of which except the youngest, are plainly diseased.

This fungus was found epidemic this year only in a small area in Gallatin National Forest, near Bozeman. A species of *Coleosporium* was found present in great abundance on the leaves of two species of *Aster* in immediate proximity to badly infected pines. The *Coleosporium* is very injurious to the leaves of the asters. From this it is possible that the telial form of *Peridermium montanum* may be a species of *Coleosporium* on *Aster*. A further study will be made of both species of rust.

4. PERIDERMIUM COLORADENSE (Dietel) Arth. & Kern

This species of *Peridermium* attacks the spruces, *Picea engelmanni* Eng., *Picea parryana* (André) Parry, and *Picea sitchensis* (Bong.) Trautre & Mayer. On the Engelmann spruce, it is found almost throughout the entire range of the species. It causes the formation of dense, deciduous, leafy, witches brooms, with greatly metamorphosed, stunted branches. The presence of the brooms usually bring about, in a few years, the death of the limbs upon which they are situated. If the limb is adjacent to the trunk, its death is often followed by the entrance of the heart-rotting fungus *Trametes pini* (Brot.) Fr.

In the region near Anaconda, Montana, where the forest trees have been killed by smelter fumes, it was noted that these witches brooms are more sensitive to the fumes than the healthy portions of the trees, and that they succumb first from their effects. The telial form of this species of *Peridermium* has not been found.

5. MELAMPSORELLA ELATINA (Alb. & Schw.) Arth.

The aecial form of this rust (*Peridermium elatinum* Kunze & Schmidt) attacks a number of species of *Abies*. It forms leafy witches brooms with adherent leaves and metamorphosed branches. These brooms have a stunting effect on the limbs upon which they occur. Where a number of brooms occur on the same tree, the whole tree is decidedly checked in its growth. The following species of *Abies* in the national forests of the west and northwest are attacked by this fungus: *A. balsamea* (Linn.) Mill., *A. concolor* (Gord.) Parry, *A. grandis* Lindl., *A. lasiocarpa* (Hook.) Nutt., *A. nobilis* Lindl., and *A. magnifica* Murr.

According to Arthur,[4] the uredinial and telial forms of this *Peridermium* occur on species of *Alsine* and *Cerastrum*. No effort has been made on the part of the writer to collect specimens of telia, as all collections were made too early in the season to find the telia. The aecia mature in the west from early July in New Mexico to the middle of August in northern Montana. The same variation in the maturing of aecia was noted in case of *Peridermium coloradense*.

[4] North American Flora 7: 111, Mar. 1907.

6. PERIDERMIUM PSEUDO-BALSAMEUM (D. & H.) Arth. & Kern

This or closely related species of *Peridermium* attacks the leaves of the following species of conifers: *Abies grandis, A. lasiocarpa,* and *A. nobilis.* The great resemblance of these forms of *Peridermium* to the aecial form of *Calyptospora columnaris* (Alb. & Schw.) Kühn. puts our determination slightly in doubt.

The aecia are usually found sparsely in rows on the leaves of the trees attacked, occurring usually only on scattering leaves, so that the effect on the vitality of the tree is of little consequence. No epidemics of this fungus have been noted, and it has been found only on younger trees as a rule. It is frequently found associated with a *Melampsora* on species of *Vaccinium,* and may be the aecial form of a species of *Melampsora* or *Calyptospora.* This, owing to the presence of other aecia in the vicinity where collections were made, should be taken only as a suggestion for future experiments. More careful studies will be made to determine the exact relationship of these rusts on the leaves of various species of *Abies* to *Melampsora* on species of *Vaccinium.*

7. PERIDERMIUM CONORUM-PICEA (Russ) Arth. & Kern

This species occurs in the west occasionally on the cones of *Picea engelmanni* Eng., causing them to be abortive. The only apparent harm done is in lessening the seed crop, but the fungus has never been found in sufficient abundance to be considered a serious hindrance to reforestation. The alternate form of the fungus has not been found.

8. CAEOMA CONIGENEUM Patouillard[5]

This species of *Caeoma* is one of the little-known forms. It attacks the cones of *Pinus chihuahuana* Eng., rendering them abortive. It occurs frequently on this host in southern Arizona, but aside from lessening the seed production, apparently does not injure the trees attacked. The telial form of this rust is unknown.

[5] Journal de Botanique 10: 386. 1896.

9. UREDO (MELAMPSORA) BIGELOWII (Thüm.) Arth.

The aecial form of this rust on larches has not been collected as yet by the writer in the national forests, but it may be common, and if search were made at the right season, it might be found. The uredinial and telial forms are found on nearly every species of willow in the west and southwest, not only where larches are found, but where there are none within a thousand miles. It has been collected on the following species of *Salix*: *Salix amygdaloides* Anderss., *S. bebbiana* Sarg., *S. cordata lutea* (Nutt.) Bebb., *S. cordata mackenziana* Hook., *S. fluviatilis* Nutt., *S. laevigata* Bebb., *S. lasiandra* Benth., *S. lasiandra caudata* (Nutt.) Sudw., *S. lucida* Muehl., *S. nigra* Marsh., *S. nuttalii* Sarg., and *S. sessifolia* Nutt.

The telial form of the fungus fruits so abundantly on some species as to exert a decidedly stunting effect. On the willows cultivated by the Forest Service near Washington, D. C., for experiments in making baskets, it is a serious parasite.

10. UREDO (MELAMPSORA) MEDUSAE (Thüm.) Arth.

Species of poplar are commonly attacked by the uredinial and telial forms of this rust, but the aecial forms, supposedly on larches, have not been found. It has been collected on the following species of trees: *Populus acuminata* Rydb., *P. angustifolia* James, *P. balsamifera* L., *P. grandidentata* Michx., *P. tremuloides* Michx., and *P. trichocarpa* Torr. & Gr., chiefly in the west and northwest. It occurs so abundantly on some species as *P. acuminata* and *P. trichocarpa,* that it injures the leaves and arrests the growth of younger trees.

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NOTES UPON TREE DISEASES IN THE EASTERN STATES[1]

Perley Spaulding

The Chestnut Blight

Some attention has been given to the chestnut blight for the past three years. It was found in July, 1909, at Middlebury, Conn., for the first time, and in September, 1909, at Bantam, Conn. Also in September, 1910, at Amherst and Springfield, Mass., and in October, 1910, at Windsor, Conn. The writer has spent most of the month of October each year in the lower Connecticut valley and the adjoining territory; much time has been spent there during the past few years besides in October. The disease was found at Windsor, Conn., the second season it was there. At any rate, it was very scattering in the Connecticut valley in the fall of 1909. A trip was made in July, 1911, as far north as Hartford, Conn., and the disease was everywhere in evidence in the Connecticut valley. There can be no doubt that in the three years, 1909 to 1911 inclusive, the disease has spread so seriously as to now be beyond hopes of control in the lower Connecticut valley.

Considerable time this season was devoted to finding out the real situation of the chestnut blight in the state of Maryland. It was found to be much more serious than at first supposed. The northeastern corner of the state cut off by a line running from the northern edge of Baltimore, east to the Delaware line, and another a little westward and then northwestward to the Pennsylvania line is already too badly diseased for eradication to be successfully carried out. Outside this area the disease is very scattering and might with relatively small effort and expense be eradicated. The course of the disease in the Connecticut valley indicates that this must be done at once or not at all. There

[1] Paper presented before the American Phytopathological Society at the meeting of December, 1911.

can be no doubt that the disease is intimately connected with the distribution of chestnut nursery stock. Repeatedly, on finding badly diseased areas, the writer either found Japanese chestnut trees or was told that chestnut stock of some sort had been brought into that vicinity some years before. The disease has been at Parkton for at least six years and probably has been there one or two years longer. The peculiar appearance of chestnut trees affected by this disease is essentially due to the girdling action of the fungus. The following instance shows this very plainly: while scouting for the disease a tree was seen which had every appearance of having been killed down to the base by the blight. It had abundant suckers around the base, the dead leaves hung on the branches; in short, the tree had every symptom of the disease except the fruiting bodies of the fungus! Upon penetrating the thicket of suckers it was found that the tree had been girdled with an axe a few months before.

LOPHODERMIUM NERVISEQUUM (D. C.) Fr.

A serious needle disease of balsam fir (*Abies balsamea* (Linn.) Mill.) has been under observation for the past five years in the Adirondack Mountains. This has been found to be caused by *Lophodermium nervisequum*. It attacks needles of all ages and occurs on trees of all sizes, but is more prevalent on the lower shaded branches or on young reproduction which is heavily overshadowed by larger trees. The disease is serious on small trees as it causes complete or nearly complete defoliation in many cases and kills the trees. The course of the disease on young leaves is fairly plain: infection begins about June first, soon after the new shoots and leaves are formed, and apparently may continue at almost any time after this date when weather conditions are favorable. The affected needles turn yellow soon, some appearing in July on the shoots of the same year. Toward fall they become more numerous and turn brown by the beginning of winter. The next April on the resumption of warm weather, a dark line shows along the middle of the leaf on the lower side; this becomes more and more prominent until about June first, when the warm rains bring about the rupture of the leaf epidermis. Along the entire length of the leaf there now appears

an open trough-like rupture with the epidermis rolled back on either side. It is probable that the period from infection to formation of mature fruiting bodies, in the majority of cases, is approximately one year, varying somewhat with weather conditions: there are apparently many cases in which this period is nearly two years and possibly even more. This disease is very prevalent in the Adirondack region and apparently occurs thoughout the range of the balsam fir. It has not yet been found in nurseries, since its host is not much grown therein.

PERIDERMIUM FRUCTIGENUM Arthur

Spores of *Peridermium fructigenum* from cones of *Tsuga canadensis* (L.) Carr., which had been collected in Connecticut two days before, were used to inoculate leaves of the following species of *Rhododendron* and *Kalmia*. *Rhododendron arborescens* (Pursh.) Torrey, *R. viscosum* (L.) Torrey, *R. nudiflorum* (L.) Torrey, *R. canescens* (Michx.) G. Don., *R. calendulaceum* (Michx.) Torrey, *R. canadense* (L.) B.S.P., *R. maximum* L., *R. catawbiense* Michx., *Kalmia latifolia* L., and *K. angustifolia* L. The inoculated plants were in a greenhouse at Washington and had their leaves further developed than would have been the case out of doors in Connecticut. This may have had an effect upon the results secured. In no case did infection occur, although the inoculations were made with and without wounds upon each species.

LIGHTNING

While engaged in reconnaisance for the chestnut blight in Maryland, the past season, the writer time and time again examined chestnut trees which at a distance apparently were affected by blight, but which were killed, either completely or partially by lightning. Occasionally groups of trees standing close together were partially killed about some central tree which usually was entirely dead. More often only single trees were struck. The frequency of occurrence of such cases soon became very noticeable, especially the latter part of the summer. There must have been an average of three or four trees per square mile which were killed or badly crippled by lightning in a single season in the territory examined by the writer.

MYXOSPORIUM ACERINUM Peck

Practically the entire season of 1911 the office of Investigations in Forest Pathology has received specimens of various species of maple which were apparently killed by *Myxosporium acerinum*. The writer found it in various parts of Vermont upon sugar maple. It is especially noticeable upon street and park trees. It starts upon small branches the size of one's finger but works back until larger ones are affected. Soon it gives the affected tree a ragged appearance and becomes noticed. All the cases seen seemed to have been entirely of the present season's standing. The only feasible method of combating this disease seems to be that of pruning out the affected parts and burning them.

PHOMA PICIENA Peck

A new disease of Norway spruce (*Picea excelsa*) has for several years been attracting the attention of pathologists. The writer's attention was called to it by the superintendent of New York State Forests in 1909, but no specimens were seen. Selby has also mentioned a disease which is probably the same one. Peck in his last report named the fungus *Phoma piciena* which occurred on leaves of red spruce (*Picea rubra*) in the Adirondacks. This summer several specimens of diseased Norway spruce were sent into the office and secured by the writer from the vicinity of Baltimore and Washington. These bore abundant fruiting bodies of a fungus which came nearer to Peck's new species than to any other. Inoculations are being made in the greenhouse. The disease is quite destructive, often completely defoliating large trees and causing their death. Apparently the only practical treatment is that of burning the fallen needles and spraying with suitable fungicides to prevent further spread of the disease.

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OROPOGON LOXENSIS AND ITS NORTH AMERICAN DISTRIBUTION

R. Heber Howe, Jr.

In a paper by the writer on the American Species of *Alectoria* (Mycologia 3: 149, 1911), *Oropogon loxensis* (Fée) Th. Fries was excluded "on the ground of its distinctive spore differences," and it was stated that the plant would be treated later in a special paper. Material of this species is confined to the larger herbaria, and is not abundant even in such collections. During last winter I have had the opportunity of studying the material in the Museum d'histoire naturelle in Paris, through the kindness of Professor Mangin and Monsieur Hariot. This material was determined by Nylander.

The genus *Oropogon* was proposed for this species by Th. Fries in 1861. It was not recognized by Tuckerman (Gen. Lich. 14: 1872) as he argued that a parallel dissimilarity of spore color

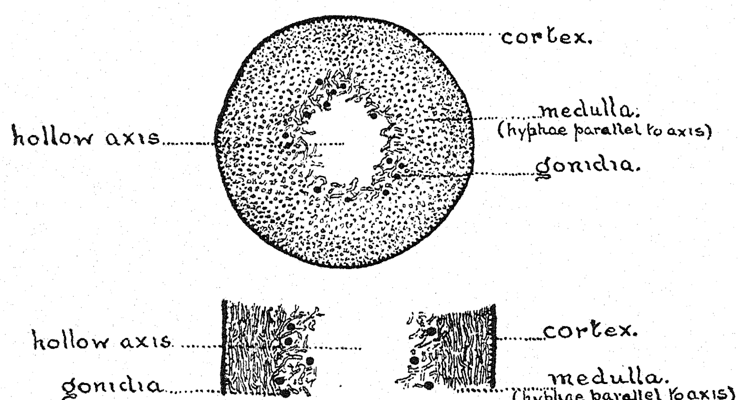

Fig. 1. Structure of Thallus of *Oropogon loxensis.*

and cell structure occurred unnoticed in other genera (*Acolium, Calcium*). Dr. Zahlbruckner (Nat. Pflanz. 220. 1907) recognizes, however, the genus not only on account of its muriform spores, but on account of its single-spored asci. Stizenberg

adopted the middle course and considered *Oropogon* as a subgenus. In my Classification de la Famille des Usneaceae l'Amerique du Nord, Paris, 1912, I followed the latter author, recognizing *Oropogon* as a section. After further study of spore characters and their phylogenetic importance (Hue, Bull. Soc. Bot. France **58**: 1911) I am inclined to give to the diverse types of spore septation generic rank, as I did in the first instance and in accord with Dr. Zahlbruckner's view.

OROPOGON LOXENSIS (Fée) Th. Fries

Type: not indicated; there is a specimen in the Museum at Paris which was collected by Bonpland and compared with the type by Nylander according to a note on the label, though the location of the type is not mentioned. Professor Dr. H. Kniep, of the Institut at Strassburg, kindly sent me the specimen here figured, which is taken for the type. The label, however, is the same as those in the Paris Museum collected by Lechler probably in 1854, and not in 1824. The specimen is decidedly atypical, and resembles more closely the boreal *Coelocaulon divergens* as stated below. Fée was a professor at Strassburg, but the type is probably in Brazil, where, however, I have been unable to locate it, although an attempt was made to do so through Dr. Neves Armond, of the Museo Nacional do Rio de Janeiro.

Orginal description: "(filamentis) tereti, laeviusculo, cinereofusco, ramosissimo, subintricato, prostato, ramulis capillaceis, tenuissimis, ultimis bifidis," . . . "(scutellis) terminalibus." Fée, Essai sur les Crypt. 137. 1824.

FIGURES: Fée, l. c. *pl. 31, f. 7,* supp. 134, 1837; et Nyl. Synop. Lich. *pl. 8, f. 16;* Zukal, Morph. und biol. Untersuch. Flecht., Sitz. Kais. Akad. Wissens. Wien. *pl. 2, f. 1.* 1895; March. Enum. Meth. Mycoph., Soc. d'et. Sci. **16**: *f. H.* 1896.

SYNONYMY: *Cornicularia loxensis* Fée, l. c.

Alectoria loxensis Nyl. Synop. Lich. 278. 1858–60.

Atestia loxensis Trevis, Flora 50. 1861.

Oropogon loxensis Th. Fries, Gen. Heter. 49. 1861.

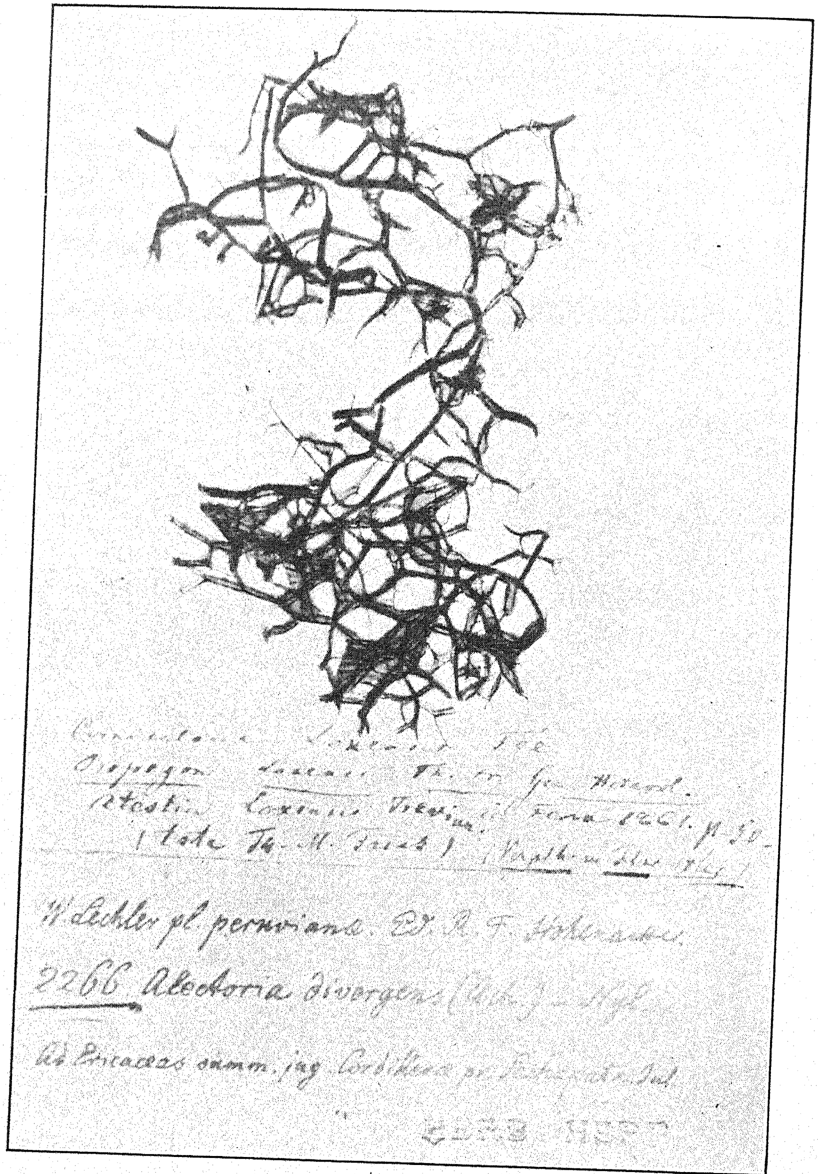

FIG. 2. Specimen of *Oropogon loxensis* in the Botanisches Institut, Strassburg; perhaps the type.

DIAGNOSIS: *Thallus* caespitose or prostrate, brown, subrigid, branches nitidous, dichotomous. Spore 1, muriform.

DESCRIPTION: typical: *Thallus* caespitose or prostrate, filamentous, slender, subrigid, brown to light brown, commonly blackening; branches terete to subterete; *cortex* glabrous or nitidous, occasionally rimulose; *primary branches* dichotomous, flexuous, entangled (max. length 15 cm.); *secondary branches* dichotomous, flexuous; *fibrils* short, furcate. *Apothecia* lateral, common, small (max. diameter 2 mm.), concave, convex, or applanate, innate-marginate, disk concolorous, chestnut or dark brown. *Spores* 55–134 × 28–48 μ.

SUBSTRATA: The plant is reported to grow both on the ground and on trees; but the collector's labels that I have examined are without data in regard to the substratum (see Hue, Lich. Ext. Europ. 95. 1901).

GEOGRAPHICAL DISTRIBUTION: Confined within our area to the alpine regions of Mexico. It has been collected on Mt. Orizaba, and at Neveria and Alvarez. Outside of Mexico it has been collected in Japan, China and Java, in Peru and Colombia, South America, and on the island of Jamaica (Merrill, Bryl. 14: 37. 1911).

OBSERVATIONS: A subspecies was proposed by Nylander, *i. e.*, *Al. Loxensis* var. *atroalbicans* (Lich. Novo Gran. Prod., Act. Soc. Sci. Fenn. 7: 20. 1863). It is simply a color form described as follows: "thallo proparte nigricante et pro maxime parte albicante." The type No. 2746, collected by Lindig at Choachi, Colombia, is now in the herbarium of the Museum d'histoire naturelle, Paris.

SPECIMENS EXAMINED

Sprague Herbarium, Boston Society of Natural History.

MEXICO: Mt. Orizaba, *Fr. Muller.*

U. S. National Herbarium, Washington.

MEXICO: Alvarez, San Luis Potosi, 8,999 ft., Sept. 1902, *Ed. Palmer.*

British Museum of Natural History, London.

COLOMBIA: Bogota.

Museum d'histoire naturelle, Paris.

L'AMERIQUE EQUATORIALE, M. A. Bonpland.

PERU: 1839–40, *M. Cl. Gay;* Carabaya, Juin-Juillet, 1847, *M. H. Alg. Weddell;* Sachapata, *W. Lechler,* 2 specimens cited by Nylander, and M. l'Abbe Hue.

MEXICO: Mt. Orizaba, 1858, *Fr. Muller.*

COLOMBIA, 3000 m., 1860, *Lindig.*

Botanisches Institut, Strassburg.

PERU: Sachapata, *W. Lechler.*

THOREAU MUSEUM NATURAL HISTORY,
CONCORD, MASSACHUSETTS.

NEWS AND NOTES

Dr. F. H. Blodgett, formerly a student at the Garden, has been recently appointed plant pathologist at the Texas Experiment Station.

Two additional plant pathologists, F. D. Bailey and H. L. Rees, have been called to the Oregon Experiment Station at Corvallis.

An important contribution to the subject of forest tree diseases, by G. G. Hedgcock, appeared in *Phytopathology* for April, 1912.

Dr. H. D. House has presented to the Garden a collection of 163 numbers of fleshy and woody fungi secured by him in the forests of Germany during the autumn of 1911.

Professor L. H. Pennington, of Syracuse University, spent the Easter holidays at the Garden studying the genus *Marasmius*, in preparation of a monograph on the subject for NORTH AMERICAN FLORA.

The large and valuable collection of unpublished drawings and descriptions left by the late Professor H. von Post, of Upsala, Sweden, has been presented to the Riksmuseum in Stockholm.

The relationship of *Diaporthe parasitica* to other fungi is discussed by C. L. Shear in the April number of *Phytopathology*. The author hopes to clear up a number of difficult questions in this connection during the coming summer.

Miss Adeline Ames, a graduate student at Cornell University, spent the month of February at the Garden studying the collection of Polyporaceae with special reference to the species occurring in the United States.

The collection of gill-fungi belonging to the herbarium of Stanford University, California, has been sent to the Garden for

study. A large number of duplicates will be retained and added to the mycological herbarium.

A collection of fleshy fungi from Sendai, Japan, has been received from Professor A. Yasuda. This is of special interest in connection with the study of species found on the Pacific coast, and may aid in determining the relationships existing between our far western flora and that of certain parts of Asia.

Cultivating *Pleurotus sapidus*.

Dr. C. L. Shear, of the Department of Agriculture, Washington, D. C., visited the Garden April 3 on his way to Europe to spend about four months in various public and private herbaria studying the types of fungi causing fruit diseases. It is necessary to seek out the types of these diseases before the new quarantine law becomes effective in this country.

We learn from *Science* that Dr. R. A. Pearson, recently Commissioner of Agriculture for the state of New York, has accepted the presidency of the Iowa State College of Agriculture at Ames. Dr. Pearson has been granted leave of absence for the summer and will visit agricultural colleges in Europe.

Dr. F. M. Bauer, Superintendent of the Metropolitan Hospital on Blackwell's Island in this city, has given us an interesting account of an experiment he tried last summer in moving an old deciduous stump from the upper part of the island to the Metropolitan grounds for the purpose of encouraging the growth of *Pleurotus sapidus* found upon it. Two or three weeks after transplanting, the mushroom fruited and yielded five crops in succession, the last one on December 17, when the accompanying photograph was taken by Dr. Bauer. Plenty of water was provided during the drought, and old blankets were spread over the stump during cold nights.

INDEX TO AMERICAN MYCOLOGICAL LITERATURE

This index is prepared by Mr. B. O. Dodge, of Columbia University, and covers the same scope for the fungi as that covered by the general index published monthly in the Bulletin of the Torrey Botanical Club. It is not reprinted on cards for distribution.

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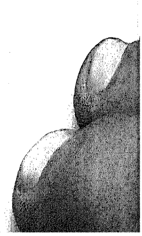

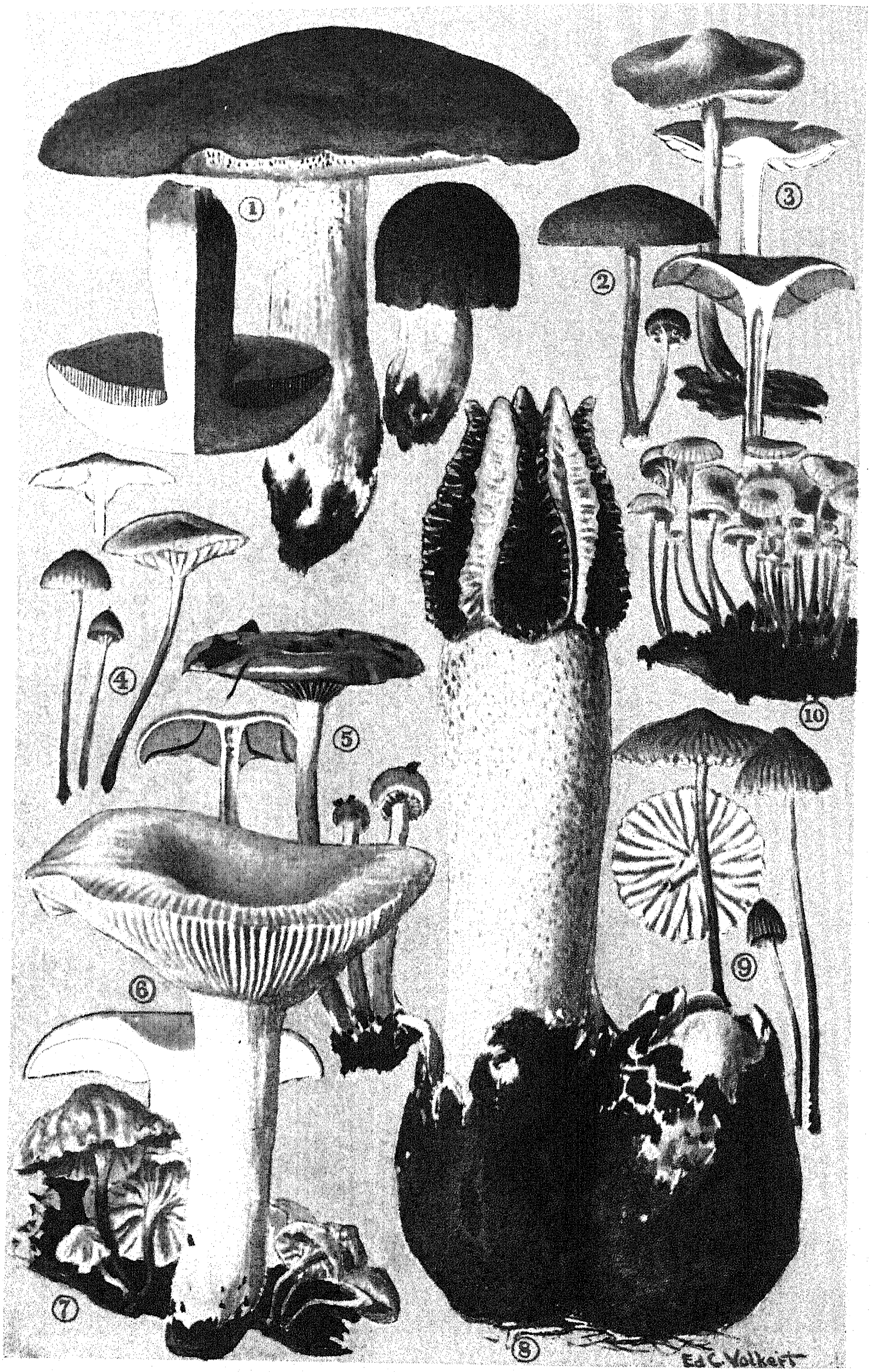

ILLUSTRATIONS OF FUNGI

MYCOLOGIA

Vol. IV — July, 1912 — No. 4

ILLUSTRATIONS OF FUNGI—XI

William A. Murrill

All of the illustrations here shown, except one, were made from plants collected in Bronx Park and the vicinity. Very few of these plants are known to be of economic importance; one or two species are generally classed with the poisonous fungi.

Suillellus luridus (Schaeff.) Murrill

Lurid Boletus

Plate 68. Figure 1. × 1

Pileus convex, gregarious or subcespitose, 5–12 cm. broad; surface dry, smooth, glabrous or minutely tomentose, sometimes clothed with rather conspicuous appressed, felted fibers, occasionally rimose-areolate, brown with shades of red or yellow, often bright brownish-red, becoming paler with age; margin thick, obtuse, entire, sometimes slightly differing in color; context firm, whitish to flavous, quickly changing to blue when wounded, sometimes unchanging in older plants, considered somewhat poisonous; tubes nearly free, rarely adnate, plane or slightly convex in mass, yellow within, changing to dark greenish-blue when wounded, mouths small, circular, cinnabar-red, becoming brownish-orange, darker with age; spores oblong-ellipsoid, smooth, olivaceous when fresh, $11–16 \times 4–6\,\mu$; stipe subequal, 5–10 cm. long, 1–2 cm. thick, usually furfuraceous or punctate, at times nearly glabrous, rarely reticulate at the apex or on the upper half, red or reddish-brown below, yellow or orange above, the dots rosy or dark-red, solid, yellow within, varied with red or purple.

[Mycologia for May, 1912 (4: 109–162), was issued May 8, 1912.]

This is one of the most variable species in the family of fleshy, terrestrial, tube-bearing fungi, but the small genus to which it belongs is readily recognized by its red or reddish tube-mouths, and all of its species should be avoided by mushroom eaters until their properties are better known. This particular species is said to contain a small amount of deadly poison, although it is often eaten. When cut, the entire cut surface of the cap, tubes, and stem changes at once to blue. It occurs often in abundance throughout temperate North America and Europe on clay banks or roadsides in open deciduous woods.

Naucoria subvelosa sp. nov.

SLIGHTLY-VEILED NAUCORIA

PLATE 68. FIGURE 2. × 1

Pileus hemispheric and gibbous to nearly plane, usually slightly umbilicate or depressed, gregarious, 1.5–2.5 cm. broad; surface viscid when wet becoming dry and polished, slightly fibrillose-scaly, especially at the center, the scales and fibrils being thin, reddish-brown, and somewhat imbricate; margin entire or undulate, inflexed when young; context mild to the taste, without odor; lamellae strictly adnate, heterophyllous, arcuate or plane to slightly ventricose, rather close, of medium width, dull isabelline-umbrinous to dirty-brownish with a ferruginous tint; spores ellipsoid, smooth, ochraceous-melleous under the microscope, 8–9 × 5 μ; stipe subequal, citrinous at the apex, isabelline below, subglabrous, bearing the remains of a slight, fibrillose, fugacious veil, cartilaginous to subfleshy, stuffed, averaging 3 cm. long and 2 mm. thick.

Type collected on a wet bank in woods in the Bronx, June 18, 1911, by W. A. Murrill.

Collybidium dryophilum (Bull.) Murrill

OAK-LOVING COLLYBIDIUM

PLATE 68. FIGURE 3. × 1

Pileus thin, convex, umbonate, becoming expanded and plane to depressed with upturned edges, solitary, 3–4 cm. broad; surface glabrous, but with fine radiating lines like appressed hairs, dry, uniformily light-brown; context mild to the taste, without

characteristic odor; lamellae adnexed, white, close, narrow, inserted, ventricose; spores ellipsoid, smooth, hyaline, 8–9 × 3.5–4 μ; stipe hollow, cartilaginous, milk-white at the apex, polished and slightly colored below, 3 cm. long, 2.5 mm. broad.

Collected by Mr. E. C. Volkert, July 31, 1911, on buried decayed sticks, acorns, and grass roots under an oak tree on a lawn in Bronxwood Park, New York City. This form is quite different in appearance from that found so commonly in our woodlands, but agrees well with plants collected in Kew Gardens, England, and elsewhere in Europe in open places. The species is edible, abundant, very variable, and very widely distributed.

Mycena praedecurrens sp. nov.

DECURRENT-GILLED MYCENA

PLATE 68. FIGURE 4. × 1

Pileus conic to subturbinate when young, then umbonate, and at length nearly plane, densely gregarious to subcespitose, reaching 1.5 cm. broad and nearly 1 cm. high; surface glabrous, very slightly viscid when wet, avellaneous, with darker avellaneous umbo; margin straight, appressed, usually striate, often yellowish-white; lamellae long-decurrent, distant, nearly plane, inserted, entire, white with an ashy tint, acute at each end; spores ovoid, smooth, hyaline, 5 × 3–3.5 μ; stipe enlarged at the apex, subglabrous, gelatinous-white, avellaneous at the base, slightly viscid when wet, stuffed, about 4 cm. long and 2 mm. thick.

The type specimens here figured were collected by W. A. Murrill in the Bronx, June 18, 1911, on a mossy bank filled with slender roots, in low deciduous woods. On account of its long-decurrent gills, one might assign it at first sight to *Omphalia*, of the type of *Omphalia Austinii* Peck, but it is not umbilicate. Its nearest relative is probably *Mycena vulgaris*.

Flammula carbonaria (Fries) Quél

CHARCOAL-LOVING FLAMMULA

PLATE 68. FIGURE 5. × 1

Pileus convex to subplane, gregarious to subcespitose, 2–4 cm. broad; surface viscid, smooth, glabrous, testaceous-isabelline, or varying from lighter yellow to orange or testaceous; margin

inflexed when young, with a slight, stramineous, filamentous, evanescent veil; context thin, white or stramineous, taste sweetish, odor pleasant; lamellae squarely adnate or with a short decurrent tooth, plane or arcuate, broad, crowded, inserted, pale-yellow to fulvous; spores ellipsoid, smooth, fulvous in mass, 7×3–$4\,\mu$; stipe equal or slightly enlarged above, hollow or stuffed, white or cremeous, adorned below with reddish-brown fibrils, glabrous or granulose at the apex, 5×0.2–0.4 cm.

This species is very common during summer and fall about burned stumps in the vicinity of New York City. It is sometimes clustered but more often gregarious, and the shining yellowish-brown caps are quite conspicuous. Fries first described the plant in Sweden, and it is known throughout Europe and in the greater part of the United States.

Russula stricta sp. nov.

STRICT RUSSULA

PLATE 68. FIGURE 6. $\times$ 1

Pileus firm, convex to expanded, becoming depressed at the center, gregarious, 5 cm. or more broad; surface dry or slightly moist, glabrous, smooth, isabelline with testaceous and ochraceous hues, the cuticle partly separable; context thin, white, firm, taste perfectly mild, odor pleasant; lamellae adnate, a few of them forked, pale-cream, close, rather narrow; spores subglobose, densely and roughly echinulate, hyaline, 6–8 μ long; stipe fleshy, subequal, smooth, glabrous, pallid, milk-white, polished, 5 cm. long, 10–15 mm. thick.

The type of this species was collected by W. A. Murrill, June 14, 1911, in thin oak woods on the eastern border of the New York Botanical Garden. Miss Gertrude S. Burlingham has very kindly compared it with known species of the genus.

Marasmius magnisporus sp. nov.

LARGE-SPORED MARASMIUS

PLATE 68. FIGURE 7. $\times$ 1

Pileus very thin, tough, convex, at times prominently umbonate, closely gregarious, 1–1.5 cm. broad; surface white to pale-isabelline with a pinkish tint, glabrous, sometimes slightly striate; con-

text mild; lamellae decurrent, broad, distant, strongly interveined, inserted, white, entire; spores large, oblong, smooth, hyaline, 10–12 × 4–6 μ; stipe increasing upward, tough, minutely longitudinally striate, pruinose to glabrous, grayish-avellaneous below, paler above, 1–3 cm. long, 2 mm. thick.

Type collected on a dead deciduous log in the New York Botanical Garden, August 28, 1911, by *W. A. Murrill.* Found commonly on dead wood in moist or shaded situations about New York City during late summer and autumn. Professor Pennington, who assigns it to the same group with *M. Vaillantii* Fries, collected it at Washington, D. C., last August on several occasions and noted considerable variation in it. *Marasmius viticola* Berk. & Curt. is a closely related species occurring in the eastern United States farther south.

Anthurus borealis Burt

NORTHERN ANTHURUS

PLATE 68. FIGURE 8. × 1

Sporophores solitary or clustered, 10–12 cm. high; stipe white, divided above into six, usually, but sometimes five or seven, narrowly lanceolate hollow arms; arms incurved above, with pale flesh-colored backs traversed their entire length by a shallow furrow; cavity of the stipe nearly closed at the base of the arms by a diaphragm through which there is an opening upward into a closed chamber with a dome-shaped wall; gleba supported on the dome and closely embraced by the arms; spores oblong, hyaline, 3–4 × 1.5 μ, borne on cross-septate basidia constricted at the septa.

This interesting and remarkable species was first described as above by Mr. E. A. Burt from New York specimens, and was later collected in Massachusetts, growing in both states in gardens or cultivated fields. It was brought to my attention in May, 1911, by Dr. F. M. Bauer, Superintendent of the Metropolitan Hospital on Blackwell's Island in this city, who found quantities of it in his mushroom beds and supplied me with a number of specimens for colored drawings and photographs.

The odor of the mature sporophore is very vile and penetrating at close range, somewhat resembling that of fresh guano, but it is not pervading like that of *Dictyophora duplicata,* for example, and

also lacks the "faint" quality of most stinkhorns. The slime containing the odor is inside the five rays and oozes through the spaces between them as they spread slightly. The "eggs" are in clusters of three or four or more, and about 3.5–4 cm. in diameter. A section of the "egg" shows the conspicuous pileus enclosed by the thin white inner wall, while the stipe is much compressed, until the elongation begins which pushes the pileus rapidly into the air, the odor at the same time advertising to flies that food is at hand in exchange for the dissemination of spores.

Mycena vexans (Peck) Sacc.

VEXING MYCENA

PLATE 68. FIGURE 9. × 1

Pileus conic to broadly convex, the umbo becoming inconspicuous with age, gregarious, 1–2 cm. in diameter; surface glabrous, not viscid, radiate-striate, uniformly fumose-avellaneous, or with the umbo slightly darker when young, margin thin, straight, concolorous; context sweetish, odor pleasant; lamellae adnate, breaking away from the stipe, broad, distant, slightly ventricose, three times inserted, white with an ashy tint; spores ellipsoid, pointed at one end, smooth, hyaline, 8–9 × 5 μ; stipe long, slender, equal, glabrous, avellaneous, nearly white at the apex, hairy at the base, hollow, cartilaginous, 5–7 cm. long, about 2 mm. thick.

The specimens here figured appeared in abundance among needles and twigs beneath a Norway spruce tree in dense woods in Bronx Park, June 14, 1911. The species was described from the Adirondack Mountains in 1885, but seems to be very little known.

Omphalopsis Campanella (Batsch) Earle

Omphalia Campanella (Batsch) Quél.

BELL-SHAPED OMPHALOPSIS

PLATE 68. FIGURE 10. × 1

Pileus thin, toughish, convex, umbilicate, often irregular, usually densely cespitose, 0.7–2 cm. broad; surface delicately striate, hygrophanous in moist weather, yellowish-ferruginous to dull reddish-yellow; lamellae narrow, decurrent, strongly arcuate, yellow, connected by veins; spores ellipsoid, smooth, hyaline,

$6–7 \times 3–4 \mu$; stipe very slender, polished, pale-brown, hollow, erect or ascending, 1–3 cm. long, adorned with brown hairs at the base.

This is one of our prettiest woodland species, found commonly and widely distributed in Europe and North America on dead coniferous wood. Its color is rather sober, but it is conspicuous by reason of its clustered habit and attractive because of its shapely form. It may be found throughout the growing season. The accompanying figure was drawn from specimens collected in late autumn, and fresh sporophores were found in the same spot the following spring at the end of April.

THE LARGE LEAF SPOT OF CHESTNUT AND OAK

Arthur H. Graves

(With Plate 69, Containing 5 Figures)

This disease we have named the "large leaf spot" in contradistinction to the small leaf spot, the latter being common on chestnut leaves, and, as is well known, caused by the fungus, *Septoria ochroleuca* B. & C.

In the summer of 1910, during a survey of the diseases of the forest trees in the Southern Appalachian region, in collaboration with the U. S. Forest Service, the writer found the large leaf spot occurring abundantly on leaves of *Castanea dentata* in Bedford County, Virginia; in Transylvania, Jackson and Macon Counties, North Carolina, and in Rabun County, Georgia. It was found commonly also on leaves of *Quercus rubra* L. in Transylvania County, North Carolina.

A similar disease has been briefly mentioned by Stevens and Hall[1] under the title of Monochetiose, in their recent book on Diseases of Economic Plants. Stating that it is abundant in the forests on chestnut leaves, and causes much loss of vigor to the tree, they refer to *Monochaetia pachyspora* Bubák as the fungous agent. The disease which they mention may be the same as that observed by the writer, and if this is so, it is probably more correct to refer it to *Monochaetia Desmazierii* Sacc. This point, however, will require further investigation.[2] Beyond the brief statement in the above mentioned work, we have been unable to find any other definite reference to such a disease in the literature.

Symptoms

On leaves of the chestnut, the large leaf spot begins to make its appearance (about August 1, in the localities visited) as small,

[1] Stevens, F. L., and Hall, J. G., Diseases of Economic Plants 438. 1910.

[2] No material of this leaf spot described by Stevens and Hall is at present available, but in all probability a new supply will be obtained this summer.

circular spots, from 1–2 cm. in diameter, on apparently healthy leaves. These spots are usually pale, with a darker line around the margin, and vary in different specimens between shades of yellow, gray, or red-brown. As the disease advances, concentric zones are added to the original diseased spot, each succeeding zone of the same nature as the original area, *i. e.*, with a darker margin bordering an interior paler area. Thus, at length, large circular spots are formed, composed of concentric, circular bands. (Pl. 69, fig. 4, and text fig. 1a.), These large spots often

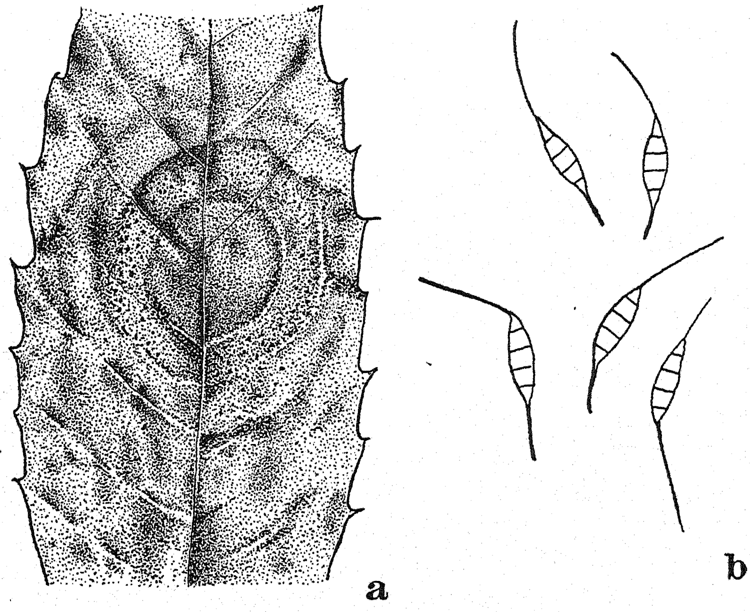

FIG. 1. a. Leaf of *Castanea dentata* showing large leaf spot. × 1. b. Spores of *Monochaetia Desmazierii* Sacc. × 600.

measure 5 or 6 cm. in diameter, stretching across the entire width of the leaf. Several large spots occurring on a single leaf may join each other, and the whole tissue in the distal portion of the leaf may thus be killed. Often, in this way, over half of the leaf may be killed. The zones are generally more clearly delineated on the upper surface of the leaf. The under side of the leaf has a whitish mouldy character on the margin of the diseased area, due to a projecting growth of the mycelium.

The disease as it appears on the leaves of *Quercus rubra* L. exhibits similar symptoms.

THE FUNGUS

The fungus causing this disease belongs to the order Melanconiales of the Fungi Imperfecti. Specimens have been submitted to Professor Farlow, who has pronounced it probably the same as *Monochaetia Desmazierii* Sacc. This fungus was originally described by Desmazières,[3] who found it in France, growing on dry or fading leaves of several species of deciduous oaks, and also on *Quercus Ilex*. It developed not on fallen leaves, but on those which remained on the tree. Desmazières named the new species *Pestalozzia monochaeta*, thus emphasizing the fact that the spores terminated in a single bristle.

Saccardo,[4] in the third volume of his Sylloge Fungorum, published in 1884, includes this and other species of *Pestalozzia* having one bristle under the section *Monochaetia*. In 1903, Allescher[5] in Rabenhorst's Kryptogamen-Flora raised this section to generic rank, thus giving the species in question the name of *Monochaetia monochaeta* (Desm.) Allescher. Such a name, however, was practically contrary to the rules of nomenclature, although, indeed, the spelling of genus and species was not exactly identical. Thus, later, Saccardo[6] in his Sylloge Fungorum evidently recognized the need of a further change, and consequently the name appears in his work at this time as *Monochaetia Desmazierii* Sacc.

According to Saccardo's description of the species, the spores are apparently smaller than ours. Professor Farlow has, however, examined the original material distributed by Desmazières himself, and finds that the spores there were immature. In material distributed later by Desmazières, which is mature, the measurements of the spores correspond to ours. This later material of Desmazières, moreover, corresponds to his own description, and

[3] Desmazières, J. B. H. J., Seizième Notice sur les Plantes cryptogames récemment découvertes en France. Ann. Sci. Nat. III. 10: 355, 356. 1848.

[4] Saccardo, P. A., Sylloge Fungorum 3: 797. 1884.

[5] Allescher, Andreas, in Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz. ed. 2. 1[7]: 667. 1903.

[6] Saccardo, P. A., Sylloge Fungorum 18: 485. 1906.

should be looked upon as the true *Monochaetia Desmazierii.* It is probable that Saccardo's smaller measurements were taken from the first lot of material distributed by Desmazières. Without going into more detail, it is sufficient for our purposes to state that the correct description of the species is given by Voglino.[7]

The spores make their appearance early in the progress of the disease, and are borne in dense clusters, or acervuli, which appear to the naked eye as small black dots on the diseased portions, usually on the upper surface of the leaf. In shape the spores are ellipsoid, and usually divided into five cells, as shown in the accompanying text figure. The three central cells are large and dark colored, while the two end cells are small and transparent. Sometimes only two, instead of three central cells appear. At the base of the spore there is a short stipe, 5–10 μ long. At the tip a long flagellum, or bristle, is borne, which usually describes a curve near its base, and is quite variable in length, 10–25 μ. The average size of the spore, including all of the cells, but omitting the stipe and flagellum, is $20 \times 6\ \mu$.

Successful infection experiments have been carried on with this fungus. Out of a large number of chestnuts sown in the greenhouse early last November, a few germinated in December and later, without waiting over until spring. By the middle of January these furnished fine healthy young trees for inoculation. The leaves were inoculated with the spores in two ways: first, by applying the spores to the surface of the leaf after wetting it with sterilized water, and, second, by wounding the leaves and inserting the spores in the wounded spots. The infections made by the latter method were invariably successful, while the former method did not always cause the disease. On the basis of these results it would appear that wounds from insect bites or mechanical causes may probably furnish in nature the starting point of the disease in many cases, and yet there is no doubt that the fungus can enter the leaf without this assistance. It is probable that the age of the leaf has some relation to infection, and investigations along this line are now being carried on.

[7] Voglino, P., Sul Genere Pestalozzia. Saggio Monografico. Atti della Società Veneto-Trentina di Scienzi Naturali 9^2: 7. 1885.

Cultures of the fungus have been made on various media. For abundant spore production and vigorous mycelial growth Clinton's[8] oat agar gave the best results. Figure 1 shows a plate culture two weeks old, on this medium. The spores here, in the central darker portion, are extremely dense. For comparison, figure 2 shows a culture of the same age, on potato juice agar. Here only a few acervuli, shown by the black dots, appear. In figure 3 some of the spores produced on the oat agar are shown. They are somewhat larger than those occurring in nature, and also considerably distorted. Figure 5 shows a germinating spore.

ECONOMIC IMPORTANCE AND CONTROL OF THE DISEASE

In some cases, individual trees were observed which had suffered a loss of perhaps 40 per cent. of the green assimilating tissue of their leaves as a result of the attacks of this fungus. Usually, however, the damage is much less than this, but always sufficient, it is believed, to cause a considerable diminution in the annual wood increment. Since it appears that this trouble is disseminated over the whole southern Appalachian region, it is one of considerable importance.

As far as the disease occurs in the forest, very little can be done at present to check it. In case of individual trees on private estates or in parks, however, the ordinary methods of spraying will probably prevent its recurrence. The diseased leaves should also be raked up in the fall and burned, as they harbor the fungus spores over winter.

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EXPLANATION OF PLATE LXIX

Fig. 1. Culture of *Monochaetia Desmazierii* in oat agar, two weeks old. × ⅔.

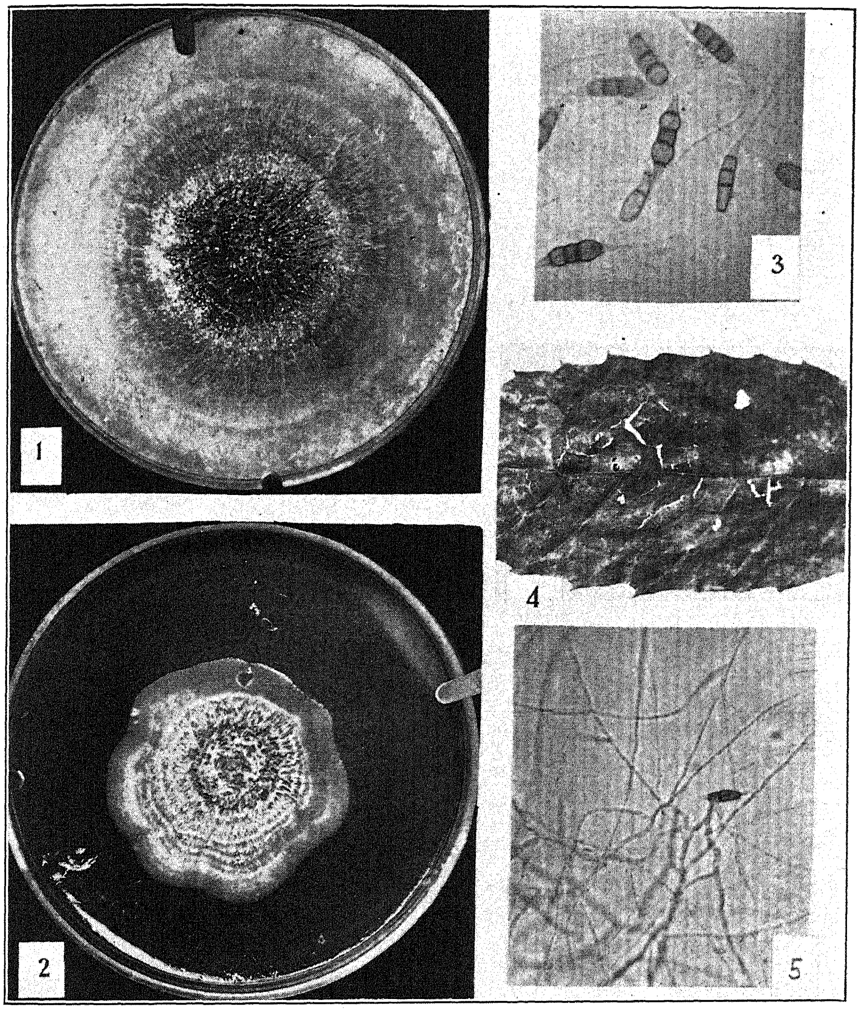
Fig. 2. Culture in potato juice agar, two weeks old. × ⅔.

Fig. 3. Photomicrograph of spores of *Monochaetia Desmazierii* Sacc. from oat agar culture. Spores somewhat abnormal, probably due to influence of culture medium. × 275.

Fig. 4. Photograph of large leaf spot on leaf of chestnut. × ⅔.

Fig. 5. Photomicrograph of germinating spore of *Monochaetia Desmazierii.* × 230.

[8] Clinton, G. P., Rep. Conn. Agr. Exp. Sta. for 1909–10. 760. June, 1911.



MONOCHAETIA DESMAZIERII Sacc.

CULTURES OF HETEROECIOUS RUSTS

W. P. Fraser

The cultures described in the following pages were undertaken during the spring and early summer of 1911. Special attention was given to the study of the aecia on conifers and their connection with telial forms, but a few cultures of the grass and sedge rusts that field observation suggested were also tried. The success attained was largely due to the excellent opportunity for field observation that the region afforded and the ease with which material could be collected.

The teliosporic material used in the cultures was collected in the districts surrounding the town of Pictou. The greater part was obtained in the spring, but considerable material was collected the previous fall and was left exposed to the weather during the winter in small cheese cloth bags. When the host plants were ready for infection, the leaves or parts of the plants bearing telia were placed in a moist chamber on damp blotting paper and then sprayed with water by means of an atomizer. When it was found by examination that the teliospores had germinated, the germinating teliosporic material was suspended above the host plants so that the basidiospores would fall on the leaves, the whole was then sprayed by an atomizer and covered for from one to several days with a bell jar. This method was satisfactory except that it frequently gave such rich infection that the plants were killed by the abundant pycnia. In all cases the teliospores were found to be germinating before the sowing was made unless stated otherwise in the descriptions. Sometimes it was found that the teliospores did not germinate in the moist chamber for several days; in some cases five to seven days were required for germination, in others a day or less was sufficient. The teliospores of the *Melampsoropsis* rusts, which mature and germinate on the living host plants in the spring, were collected when germinating, or the mature telia were placed immediately after collection in a moist chamber until they germinated freely, which usually took place in about twenty-four hours.

Many of the host plants used in the cultures were obtained in the field and placed in pots in early spring, but some were procured a short time before the experiments were made. Care was taken to select the plants remote from any source of infection and the surrounding plants of the same species from where they were obtained were kept under observation and remained free from infection except in one case which is noted in the description of the experiment. Plants from the same place as those used for the cultures were also kept as checks in every experiment and in no case did infection appear.

The experiments were carried on in a well-lighted laboratory of Pictou Academy, with the exception of one at the end of the season which was performed at the Agricultural College, Truro, N. S.

The writer's thanks are due to Dr. J. C. Arthur for valuable suggestions and assistance, to Professor H. W. Smith, Biologist of the Agricultural College, Truro, for enthusiastic and valuable assistance in field observation in the vicinity of Truro and in the culture carried on at the College, and also to Mr. John Macoun, Naturalist of the Geological Survey of Canada, for determining some of the host plants.

PUCCINIASTRUM PUSTULATUM (Pers.) Dietel

During the summer of 1910 there was a very luxuriant development of this rust on *Epilobium angustifolium* L. in a small area that had been previously swept by fire. The leaves with telia were collected the following spring and gave excellent germination after from four to six days in a moist chamber. A sowing was made on *Abies balsamea* on May 17. Pycnia were noticed on May 24 and aecia on June 1. Another sowing on May 22 gave pycnia on May 29 with aecia on June 4. Infection was very marked in both cultures, practically all the young leaves being infected. Another sowing was made on June 19 with a few pycnia on June 27 and aecia on July 4. By this time the leaves of the host plants were becoming mature and the infection was sparing. A sowing was also tried on *Tsuga canadensis* but without result.

Aeciospores from the culture aecia were sown on *Epilobium*

angustifolium L. on June 14 and the uredinia of *Pucciniastrum pustulatum* were noticed about two weeks later.

In the field where the telia for the culture were collected, a few trees of *Abies balsamea* grew among the rusted *Epilobium*. These were watched for the appearance of pycnia and aecia and the first collection was made on June 19, when the pycnia were well developed but the aecia were not mature. Several collections were made later but the aecia were few considering the abundance of the telia and the fact that all tested in the laboratory gave excellent germination. Probably the scant development was due to the very dry weather that prevailed during May and June until the leaves of the host were too old to be readily infected. In the laboratory tests, at least four days in a moist chamber were necessary for the germination of the teliospores.

European investigators have shown that the aecial stage of this rust is on *Abies pectinata* DC., but as far as the writer is aware these are the first experiments with American material and the first collection of aecia in North America.

CALYPTOSPORA COLUMNARIS (A. & S.) Kuhn

The swollen stems of *Vaccinium pennsylvanicum* Lam. bearing the telial stage of this rust were placed in a moist chamber on May 12 and the teliospores were germinating freely by May 17. A young plant of *Abies balsamea* (L.) Mill. was then infected on the latter date in the usual way. Aecia were first noticed appearing on June 3 and were mature by June 12. There was no trace of pycnia. An attempt was made to infect *Tsuga canadensis* (L.) Carr., but without success.

In the field, aecia began to appear during the last week of June and were abundant on the host in this region (*Abies balsamea*) during the first and second weeks of July.

Arthur (Mycol. **2**: 231. 1910) infected *Abies Fraseri* (Pursh) Poir, using telial material from this region. This is the only previous culture with North American material.

MELAMPSOROPSIS LEDICOLA (Peck) Arthur

Teliosporic material of this rust on *Ledum groenlandicum* Oeder was *sown on Picea canadensis* (Mill.) BSP. on June 5.

Pycnia were evident on June 13 in great abundance and aecia followed in two or three weeks. Two host plants were used and the infection was marked on both. The aecia were without doubt *Peridermium decolorans* Peck. Another sowing on June 17 gave pycnia on June 27 followed by aecia. This confirms the work of last year. (Mycol. **3**: 70. 1911.)

MELAMPSOROPSIS CASSANDRAE (Peck & Clinton) Arthur

Teliosporic material of this rust on *Chamaedaphne calyculata* (L.) Moench was sown on *Picea rubra* (DuRoi) Dietr. on June 16; pycnia were noticed on June 26, and aecia were mature by July 16. Both pycnia and aecia were very abundant. Another sowing on *Picea mariana* (Mill.) BSP. on June 17 gave pycnia which were noticed first on July 3. Aecia followed, but not in abundance, probably owing to the maturity of the leaves. The aecia belonged to *Peridermium consimile* Arthur and Kern. Frequent collections of aecia were made in the field on the *Picea* that grew beside the *Ledum,* which bore germinating telia in the spring. (For previous culture see Mycol. **3**: 68. 1911.)

MELAMPSOROPSIS ABIETINA (A. & S.) Arthur

Teliosporic material on *Ledum groenlandicum* was sown on *Picea rubra* on July 16, with pycnia on June 27 and aecia on July 8, both in great abundance. A sowing was tried on *Picea canadensis* without result, but the leaves were too old for the experiment to have any value as negative evidence. This confirms the work of last year (Mycol. **3**: 69. 1911). The aecia were found to be *Peridermium abietinum.* Several collections were made in the field beside where the telia were germinating on *Ledum* in the spring.

UROMYCES SCIRPI Burr.

Teliosporic material of this rust on *Scirpus campestris* var. *paludosus* (A. Nelson) Fernald (*S. paludosus* A. Nelson) was sown on *Cicuta maculata* L. on June 9. Pycnia appeared on June 16 and aecia followed in a short time, both in abundance. Arthur (*Jour. Myc.* **13**: 199. 1907; **14**: 17. 1908; Mycol. **1**:

237. 1909) has shown by cultures that this rust on *Scirpus fluviatilis* (Torr.) A. Gray has aecia on *Cicuta maculata*.

A species of *Uromyces* on *Scirpus validus* Vahl. was collected near Pictou. The collection differed from typical *Uromyces Scirpi* in having the telia embedded in the tissues and placed immediately beneath the stomata. The teliospores are also short pedicelled and mostly irregular in shape. Dr. Arthur places this collection under *Uromyces Scirpi*. Attempts were made to germinate the teliospores but without success.

UROMYCES PECKIANUS Farl.

Teliosporic material of this rust on *Distichlis spicata* (L.) Greene collected near Pictou was sown on *Atriplex patula* L. on May 16 with pycnia on May 25 and aecia appearing by May 30. Another sowing was made on June 3 with pycnia on June 10 followed by aecia which were mature by June 24. A sowing on *Chenopodium album* L. on June 2 showed pycnia by June 10 followed by abundant aecia which were mature by June 23. These experiments confirm the work of last year (Mycol. 3: 72. 1911).

Two successful sowings were also made on *Salicornia europaea* L., but with such scant infection that little value can be placed on the experiments. It is very probable, however, that the aecia on *Salicornia* belong to this species. The morphology of the aecia support this view.

Attempts were also made to infect *Suedia maritima* (L.) Dumort and *Spergularia canadensis* (Pers.) Don., but without success. It seems probable to the writer, however, that the aecia collected on *Suedia* among the rusted *Distichlis* is connected.

PUCCINIA PERPLEXANS Plow.

Teliosporic material of this rust on *Alopecurus pratensis* L. was collected near Pictou and sowings were made on two plants of *Ranunculus acris* L. June 2. Pycnia were noticed on both June 11 and aecia began to appear June 21. The infection was marked on both plants, the leaves, stem and pedicels being infected.

Aecia developed abundantly in the field on *Ranunculus acris* L.

that grew among the rusted *Alopecurus.* The first collection was on June 28.

The life history of this species has been worked out by Plowright and other European investigators, but this is the first experiment with North American material, so far as the writer is aware.

PUCCINIA ALBIPERIDIA Arth.

A few collections of *Puccinia* on *Carex* were sown successfully on *Ribes* as described below. All are placed under this species for the present, until further study determines their true position.

Puccinia on *Carex intumescens* Rudge was sown on *Ribes prostratum* L'Hér on May 3 with abundant pycnia and aecia on May 12 and May 24 respectively. Another sowing on the same host on May 25 showed pycnia on May 30 followed by aecia in a short time. Two attempts were made to infect young thrifty plants of *Ribes oxyacanthoides* L. but without success. A sowing on *Sambucus racemosa* L. also failed.

Puccinia on *Carex crinita* Lam. was sown on *Ribes oxyacanthoides* L. on May 7 followed by pycnia on May 15 and aecia on the 24th, both in abundance. Another sowing on the same host on June 16 was followed by pycnia on June 21 and aecia on July 2. Infection was very abundant on the young stems and leaves. A sowing on *Ribes prostratum* on May 6 showed pycnia on May 14 and aecia on May 24. Arthur (Jour. Myc. **14**: 13. 1908) sowed teliosporic material from *Carex crinita* successfully on *Ribes Cynosbati* L.

Puccinia on *Carex debilis* var. *Rudgei* (*Carex tenuis* Rudge) was sown on *Ribes prostratum* on May 21 with pycnia on May 29, followed in a short time by many aecia. A collection from this region was sown on *Ribes Cynosbati* the preceding year by Arthur (Mycol. **4**: 13. 1912).

Puccinia on *Carex arctata* Boot. was sown on *Ribes oxyacanthoides* on June 2. Pycnia appeared abundantly on June 11. Aecia appeared but they did not flourish and only a few matured. Sowings were also tried on *Sambucus racemosa* and *Aster acuminatus* Michx. but without infection.

PUCCINIA CARICIS-SOLIDAGINIS Arth.

A collection on *Carex scoparia* Schk. was sown on *Solidago graminifolia* (L.) Salisb. on May 7 with pycnia May 25 and aecia on June 13. Arthur (Mycol. 4: 15. 1912) established this connection with teliosporic material collected in Maine.

A *Puccinia* on *Carex stipata* Muhl. heretofore called *Puccinia Peckii,* was sown on *Solidago* (*rugosa?*) on June 5 with very abundant pycnia on June 11, but the plants died soon after, so that the aecia did not mature. Strong field evidence of connection suggested the sowing. It seems from the culture and the field observations that the *Puccinia* on *Carex stipata* which has passed as *Puccinia Peckii* in this region belongs to *P. Caricis-Solidaginis.*

PUCCINIA ASTERIS-CARICIS Arth.

Teliosporic material from *Carex trisperma* L. was sown on *Aster acuminatus* Michx. on June 12 with pycnia on June 20 and aecia by July 1, both in great abundance. Another sowing on July 10 on the same host also gave abundant pycnia and aecia. This connection was supported by strong field evidence.

UROMYCES PERIGYNIUS Halst.

A collection of teliosporic material on *Carex deflexa* Hornem. was sown on *Solidago* (*rugosa?*) on May 25 with pycnia on June 1 and aecia on June 21. Another sowing on May 25 on *Solidago bicolor* L. gave pycnia on June 6 followed by aecia on June 21, both in abundance.

Another collection on *Carex scoparia* was sown on *Solidago graminifolia* (L.) Salisb. on May 28 with very abundant pycnial infection by June 6. The plants died in a few days, probably from the severe infection. The field evidence of the connection of these forms was as conclusive as such evidence could be.

A collection on *Carex intumescens* was sown on *Solidago* (species undetermined) successfully. Field evidence of connection suggested a sowing on *Aster* which was made on June 15, with very abundant pycnia on June 25 but the plants died in a few days later, probably from the severe infection, so that no aecia developed. The species of *Aster* was probably *puniceus,* but a certain determination could not be made.

These experiments tend to confirm the experiments of Arthur (Mycol. 4: 21. 1912) with this species and add another telial host, *Carex scoparia,* as anticipated.

NECIUM FARLOWII Arth.

This rust was found to occur abundantly during the summer of 1910 on the leaves and twigs of a number of trees of *Tsuga canadensis* that grew near Pictou. It was most common on trees from ten to fifteen feet in height and practically all the twigs at the top of the infected trees were killed by the fungus. The rusted leaves soon fell away but the twigs remained during the winter. Some of these twigs bearing telia were collected in the fall and wintered. Collections were also made from the trees in the spring, and both collections gave good germination in a moist chamber in a few days.

A sowing was made on *Tsuga canadensis* on June 5 and by the 14th the leaves began to turn yellow, indicating infection and telia were present by the 21st. No pycnia were formed. Another trial on June 11 gave telia by June 27 and a third on June 14 was also successful, the telia being first noticed on June 27. Telia began to form on the twigs a few days later than on the leaves.

The infected twigs that remained on the trees in the field were observed germinating on June 14 after a day or two of showery weather. The germinating telia could be easily recognized on close examination as they became reddish in color and swollen and velvety in appearance. Microscopic examination showed the promycelia to be rather large with spherical basidiospores 8–10 μ in diameter, of a deep reddish color. The young leaves in the vicinity of the germinating telia began to show infection by the first of July and well developed telia were collected on July 5. Infection of the twigs soon followed. The cones on the overhanging branches of a large hemlock also became infected, the first collection being made on July 8.

Arthur in NORTH AMERICAN FLORA regards this species as possessing telia only and possibly pycnia. These observations and experiments confirm this view and indicate that pycnia are absent.

MELAMPSOROPSIS PYROLAE (DC.) Arthur

The association of this rust with *Peridermium conorum-Piceae* (Rees) Arthur was discussed in a previous paper (Mycol. 3: 70. 1911). This season's experiments were carried on for the purpose of establishing the connection of these forms.

Three trees of *Picea mariana* (Mill.) BSP. were taken into the laboratory just when the cones were bursting the scales, and on May 26 plants of *Pyrola* bearing germinating teliospores were suspended above so that the basidiospores would fall on the cones. Two of the trees soon died, the third grew for a time and the cones developed. Pycnia were noticed on June 17, followed by the aecia of *Peridermium conorum-Piceae*. The aecial spores were being shed by July 16. Only one cone became infected, out of about fifteen that grew on the tree.

Experiments were also tried in the field. Two trees about fifty yards apart were selected in a grove of *Picea* on a point that juts into the harbor. The grove was surrounded on the landward side by cultivated fields and was a mile or more distant from any suspected source of infection. Plants of *Pyrola* bearing germinating teliospores were suspended on May 29 above the cones as in the experiment in the laboratory, provision being made to keep their roots moist. On June 26 the cones of both trees were covered with pycnia which probably appeared a week or more earlier, as only occasional visits were made to the place. Aecia were present by July 4 and the spores were being shed by July 8. One of the trees was *Picea mariana;* of the 21 cones that it bore, all but one were infected. There were 14 cones on the other tree (*Picea canadensis*), of which 9 were infected. The cones of the trees (*Picea*) that grew everywhere near were carefully examined and no infection was found in the vicinity or within more than a mile of the place where the experiments had been made. When the aecial spores are being shed the infected cones are conspicuous and not likely to be overlooked especially on small trees. Even the pycnial stage is also conspicuous as the scales turn yellow, and yellow-colored resin oozes freely from the cones. The most of the trees in the grove were small, not over 20 feet in height, but cones were plentiful. For convenience, the smallest trees with few cones were selected for the experiments.

The plants of rusted *Pyrola* used in the experiments were *Pyrola americana* Sweet and *P. elliptica* Nutt.

While the experiment in the laboratory cannot be regarded as conclusive owing to the scant infection and the remote possibility of the cones having been infected before the trees were taken in to the laboratory, yet the experiments in the field seem to the writer to show beyond reasonable doubt that *Peridermium conorum-Piceae* is the aecial stage of *Melampsoropsis Pyrolae.*

The poor infection in the laboratory experiments may have been due to the fact that the tree was not in a flourishing condition or that the provision made to keep the atmosphere moist about the cones was not sufficient, or, as the writer believes, to the cones not being old enough when the sowing was made. In the field experiments the cones were more mature. It was also found that *Pucciniastrum minimum* readily infected the cones of *Tsuga* when they were so far developed that infection was regarded as doubtful.

In the region where the *Pyrola* rust was collected, the teliospores began to germinate about May 24. The pycnia of *Per. conorum-Piceae* were noticed on the cones of *Picea mariana* in the vicinity on July 1, and the aecial spores were being shed on July 16. The *Peridermium* was rather rare, only a cone or two showing infection on the trees attacked, and in all only about two dozen cones were collected, where they could be collected in hundreds the preceding season.

PUCCINIASTRUM MINIMUM (Schw.) Arthur

During the summer of 1910, in a small area that had previously been swept by a fire, a very luxuriant growth of *Rhodora canadense* (L.) BSP. resulted, and on the leaves of the *Rhodora* a splendid development of the uredinia and telia of this rust was present. To gain some clue to the aecial stage, leaves were gathered in early spring and placed beneath small trees of *Abies canadensis* and *Tsuga canadensis* and small trees of the same species were planted among the rusted *Rhodora.* Trees of *Picea* grew near the *Rhodora,* so these were not experimented with. It was thought most probable that the aecial host was either *Abies* or *Tsuga.*

Leaves with telia were also collected and the teliospores were

germinated in a few days in a moist chamber. A sowing was made on *Abies balsamea* and *Tsuga canadensis* on June 13 with pycnia on the latter on June 20, and aecia on July 1, but without infection on the former. Another sowing on the same hosts on June 17 gave pycnia on *Tsuga canadensis* on June 26 and aecia on July 4 but without infection on *Abies.* A third sowing was made with the same results.

In the field the infected leaves of *Rhodora* had been placed under two trees of *Tsuga canadensis* in different places and in both there was a most decided infection of the neighboring leaves; the trees of *Tsuga* that had been planted among the rusted *Rhodora* also developed aecia, but *Abies* did not. The writer's attention was now called to Arthur's description of *Per. fructigenum* (Bull. Torrey Club 37: 578. 1910) on the cones of *Tsuga ciniastrum minimum,* and also to Spaulding's collection of aecia on the leaves of the hemlock which he regarded as belonging to this species (Phytopath. 1: 94. 1911). Experiments were now tried to determine if the cones could be infected.

As it was not practicable to take cone-bearing trees of *Tsuga canadensis* into the laboratory, branches with cones were placed in water and a fresh surface was exposed to the water every day or two by removing a small portion of the end of the twig. A sowing was made on the cones and leaves on June 18 with abundant pycnia on the cones and leaves on June 26. Aecia developed abundantly on the leaves by July 8 and a few aecia appeared on the cones a day or two later. Another sowing was made on June 22 with pycnia on the cones and leaves in abundance on July 2 and aecia on the leaves by July 8, also in abundance. Two or three days later a few aecia appeared on the cones.

About the same date, during a day or two of showery weather, leaves of the *Rhodora* with germinating telia were collected in the field and placed on the cones of a large tree of *Tsuga canadensis.* Some of the material was also thrown beneath and over a small tree of the same species. Pycnia appeared abundantly in about a week on the cones and leaves of both trees. There was also a most luxuriant development of aecia on the leaves, but only a few aecia matured on the cones.

Dr. Spaulding generously furnished material from his collec-

tions of *Peridermium fructigenum* Arth. for comparison, but it seemed to be distinct from the culture aecia. Several collections of aecia were made during the summer of 1910 and 1911 in various parts of the province on *Tsuga canadensis.* These collections were regarded by the writer as *Peridium Peckii* and the field evidence clearly indicated a connection with *Pucciniastrum Myrtilli* on *Vaccinium pennsylvanicum* and *V. canadense.* The culture aecia, both field and indoor, of *Pucciniastrum minimum* were so much paler in color than the aecia regarded as *Peridermium Peckii* that the writer was inclined to consider them distinct. Material was sent to Dr. Arthur for determination. He replied that the aecial form from *Pucciniastrum minimum* was *Peridernium Peckii* and the form that seemed to be connected with *Pucciniastrum Myrtilli* was distinct.

These cultures seem to the writer to prove that the aecia of *Pucciniastrum minimum* (Schw.) Arthur are on the leaves and cones of *Tsuga canadensis* and according to the determination of Dr. Arthur belong to *Peridermium Peckii* Thüm.

UROMYCES SPARTINAE Farl.

For three successive years aecia were collected on *Spergularia canadensis* (Pers.) Don near Pictou. The aecia seemed to be connected with *Uromyces Spartinae* on *Spartina patens* (Ait.) Muhl. and *S. glabra* var. *alterniflora.* Attempts were made, in the spring of 1910, to test this supposed connection by cultures, but the teliospores failed to germinate. On June 10, 1911, aecia were found to occur very abundantly on *Arenaria lateriflora* L. in several places, and in each the distribution of the aecia seemed to leave no doubt that they were connected with the *Uromyces* on *Spartina Michauxiana* Hitch. As abundant material of this rust on the three species of *Spartina* common in this region had been collected in early spring for use in culture work and was found to give good germination, experiments were tried to test the suspected connection.

A sowing of teliosporic material from *Spartina Michauxiana* was made on *Arenaria lateriflora* on June 11 with pycnia on June 17 and aecia on June 27, both in abundance on the young leaves and stem. Another sowing on June 12 gave pycnia on June 18

and aecia on June 27, also in abundance. Another sowing on June 27 gave pycnia on July 7 and aecia on July 16, but not in such abundance, probably owing to the maturity of the leaves. Three different sowings were made on *Spergularia canadensis* and one each on *Stellaria media* (L.) Cyrill., *S. graminea* L., and *Glaux maritima* L. without infection in any case.

Teliosporic material from *Spartina glabra* var. *alterniflora* was sown on *Spergularia canadensis* on June 12 with pycnia on June 20 and aecia on June 27. A previous sowing on the same host was successful, but the dates were not kept. Two sowings were made on *Arenaria lateriflora* without infection.

A sowing of teliosporic material from *Spartina patens* was made on *Spergularia canadensis* on June 12 with pycnia on June 20 and aecia on June 27. Two further sowings made, one on June 27 and the other on the 28th, were also successful, producing pycnia and aecia in due time. Two sowings were made on *Arenaria lateriflora* and one on *Salicornia europea* without infection.

The field observations and cultures show that *Uromyces Spartinae* on *Spartina Michauxiana* has aecia on *Arenaria lateriflora* but not on *Spergularia canadensis,* while the same rust on *S. patens and S. glabra* var. *alterniflora* has aecia on *Spergularia canadensis* and not on *Arenaria lateriflora.*

Dr. Arthur studied the field collections and culture material here described for vol. 7, part 3, of NORTH AMERICAN FLORA, which includes this species. His conclusions in regard to the position of this species can be gathered from his treatment of it in that work.

MELAMPSORA ARCTICA Rostr.

A species of *Caeoma* was found to occur abundantly on *Abies balsamea* during the early summer of 1910. A collection of the material was sent to Dr. Arthur, who suggested that it might be the aecial stage of *Melampsora arctica* Rostr. Field study confirmed this suggestion, as the willows in the neighborhood of the *Caeoma* soon developed uredinia and telia of *Melampsora artica* Rostr. Leaves with telia were collected in the fall and wintered and the teliospores gave good germination in a few days in a moist chamber. A sowing was made on *Abies balsamea* on May

27. Pycnia appeared on June 2 followed by aecia in a few days. Another sowing was made on two trees of the same host on May 30, with pycnia by June 3 and aecia by June 10. Two different sowings were made on *Larix laricina* (DuRoi) Koch but no infection followed. The willow from which the teliosporic material used in the experiments was obtained was determined as *Salix discolor* Muhl. by John Macoun. Collections were also made on *Salix rostrata* Richards.

The *Caeoma* was not so common in the summer of 1911 as in the previous season, probably owing to the dry weather, but the collections made were in the vicinity of willows that were infected with this rust the preceding year. It does not seem to have been previously collected. The pycnia are numerous, hypophyllous; the aecia hypophyllous, rather large and conspicuous; the aeciospores ovoid or globose, $13–16 \times 15–24\,\mu$; wall rather thick, $2–3\,\mu$, finely verrucose; contents orange.

MELAMPSORA (MEDUSAE Thüm.?)

During the summer of 1910 several small hemlocks in the natural park at Truro, N. S., were observed to be so severely infected by *Caeoma Abietis-canadensis* Farl. that it suggested local infection. In the fall of the same year, the writer, in company with Professor H. W. Smith, of the Truro Agricultural College, visited the place and careful search was made for some clue to the telial stage. No rust was found in the vicinity, except a *Melampsora* on *Populus grandidentata* Michx., several trees of which grew near. This was regarded as *Melampsora Medusae* Thüm. and examination seemed to confirm this view. As the aecial stage of this rust has been shown to occur on *Larix*, the proximity of the poplar rust was thought to be of little significance.

Teliosporic material on *Populus grandidentata*, however, was collected near Pictou in the spring, and on June 9 sowings were made on *Larix laricina* and *Tsuga canadensis*. A few pycnia appeared on the *Larix* on June 25 but there was no further development, although the plants remained in good condition. Pycnia appeared on *Tsuga canadensis* on June 16 and aecia of the *Caeoma* type on June 25. Another sowing on *Tsuga canadensis* on June 19 gave pycnia on June 27 and aecia on July 4, and a

third sowing on June 21 gave pycnia on June 30 with aecia on July 8. Two more sowings were tried on *Larix laricina* without result.

The teliosporic material was collected from a grove of young poplars that were severely attacked by the *Melampsora* the previous season. A visit to the place showed that several young trees of *Tsuga canadensis* grew among the poplars and these were carefully watched for the appearance of aecia. Pycnia and aecia were first collected on June 19. A very rich infection of the trees of *Tsuga* in the immediate vicinity soon followed. The young trees about a foot in height, beneath which were many poplar leaves with the telia of the *Melampsora,* showed an exceedingly rich infection, practically all the leaves and many of the twigs being infected. The poplars were also watched and in due time the uredinia of the *Melampsora* appeared. The distribution was such that it indicated the source of infection to be the *Caeoma* on the *Tsuga.* Similar observations were carried out at Truro, but the place could not be visited often and the observations were not so complete. The observations and cultures leave no doubt in the mind of the writer that the *Melampsora* on *Populus* in the region studied by the writer has aecia on *Tsuga canadensis,* and that the aecia are *Caeoma Abietis-canadensis.* It seems probable that the species discussed is a form of *Melampsora Medusae* with aecia on *Tsuga canadensis.* The weak pycnial infection of *Larix* in one culture seems to support this view but further study is needed. The field collections of aecia were submitted to Dr. Arthur, who confirmed the determination.

A *Caeoma* was often collected in this region on *Larix laricina.* As there seem to be no good characters for separating the aecia of *Melampsora Medusae* and *M. Bigelowii,* both of which have been shown by cultures to occur on *Larix,* it was impossible to determine to which species these collections belonged. The field evidence, though not very strong, indicated that all the collections on *Larix* belonged to *Melampsora Bigelowii* Thüm.

PERIDERMIUM BALSAMEUM Peck

This *Peridermium* was found abundantly on *Abies balsamea* (L.) in all the regions of Nova Scotia visited by the writer.

Field observations made during 1910 seemed to point to *Pucciniastrum arcticum* on *Rubus* as the telial stage (Mycol. 3: 72. 1911). It was also noticed that *Uredinopsis mirabilis* (Peck) Magn. was associated in a very striking way with the same *Peridermium*, but it was not considered probable that they were related. However, as observations made during the early summer of 1911 seemed to point to their connection, a sowing of the *Peridermium* was made on a pot of *Onoclea sensibilis* on July 7. Uredinia were observed abundantly on July 16. At this date the filaments of urediniospores were oozing out. As the plants of *Onoclea* were grown from rhizomes taken into the laboratory in early spring, there was no chance for infection before the sowing. Later study, however, suggested that urediniospores may have been present on the *Onoclea* which grew beneath the *Abies* shoots used in the culture experiment, and that infection may have possibly come from urediniospores clinging to the leaves. It was some time after the appearance of the *Peridermium* that the collection was made for the culture, so that there was sufficient time for the urediniospores to appear on the ferns even if they developed from the aecia on *Abies*. No record was made at the time of collection of the presence of the fern rust, but later it was abundant on the *Onoclea* beneath the fir and may have been present at the time of collection of the aecia.

On July 17 another sowing was made on a number of plants of *Onoclea sensibilis* that had been obtained in the field on the same day. Uredinia appeared on all about July 25. One pot of plants kept as a check remained free from infection, but a few plants of *Onoclea* in the field alongside of those that were used for the culture showed uredinia on July 31. The possibility of the plants being infected before being taken into the greenhouse is not therefore excluded, so the experiment does not establish the connection of the *Peridermium* and the fern rust.

During the season the distribution of *Peridermium balsameum* and *Uredinopsis* on ferns was carefully studied in the field and their association was so marked that the writer concluded it could not be accidental. There was evidence to show that more species than one are included under this *Peridermium*. The first appearance of the aecia was during the last week of June and the

first weeks of July. These aecia appeared to be connected with *Uredinopsis mirabilis* on *Onoclea sensibilis.* A second crop appeared about the first of August and lasted during the month. These seemed to be connected with *Uredinopsis Osmundae* and *U. Phegopteridis.* There was a striking difference between the field appearance of the earlier and later aecia, and the spores of the former averaged about 8 μ smaller than the latter.

The writer is convinced that at least two forms are confused under *Peridermium balsameum* and that these are connected with *Uredinopsis* on ferns. It may be that one is also the aecial stage of *Pucciniastrum arcticum* on *Rubus.* There was considerable field evidence to support this view, but that does not seem probable. Preparations have been made to carry on further experiments next year, and the writer looks forward with confidence to throwing some light on the life history of the fern rusts so little understood at present.

Attempts were made to germinate the urediniospores of *Uredinopsis mirabilis* and with some success. Germ tubes emerged from germ pores, two placed near the beak and two near the base of the spore. The germ tube was that of the usual uredospore but very small. Two germ tubes only emerged from each spore on germination usually, one from the oppositely placed pores either at the apex or base, but sometimes both on the same side of the spore. Attempts were made to infect plants of *Onoclea sensibilis* with uredospores and the experiments were successful but opportunity was not given to follow the experiments carefully. The experiments indicated, however, that the first spore to appear in the fern rust is the uredospore and that it is functionally a uredospore.

PUCCINIASTRUM AGRIMONIAE (Schw.) Tranz

There was a very rich development of both the telial and uredinial stages of this rust on *Agrimonia gryposepala* Wallr. near New Glasgow for several years, but no clue to the aecial stage was noticed. All the conifers of the region grew among the rust except *Tsuga canadensis.* Repeated attempts were made to germinate teliosporic material from this place but without success. Leaves of the host were suspended above young trees of *Tsuga*

canadensis and *Abies balsamea* lest some germinating telia might have escaped detection but there was no result. Uredinia were collected on the young leaves of *Agrimonia* in May, and this would indicate that probably the rust is either carried over the winter by the urediniospores or is perennial in the rootstock or roots, as the young leaves of the conifers were not open at the time of the collection.

SUMMARY OF CULTURES DESCRIBED IN THIS ARTICLE

1. *Life histories supplementing previous work of the writer or other investigators*

Pucciniastrum pustulatum (Pers.) Dietel. Teliospores from *Epilobium angustifolium* L. infected *Abies balsamea* (L.) Mill. Aeciospores from *Abies balsamea* infected *Epilobium angustifolium* L.

Calyptospora columnaris (A. & S.) Kuehn. Teliospores from *Vaccinium pennsylvanicum* Lam. infected *Abies balsamea* (L.) Mill.

Melampsoropsis ledicola (Peck) Arthur. Teliospores from *Ledum groendlandicum* Oeder infected *Picea canadensis* (Mill.) BSP.

Melampsoropsis Cassandrae (Peck & Clinton) Arthur. Teliospores from *Chamaedaphne calyculata* (L.) Moench infected *Picea rubra* (DuRoi) Dietr. and *Picea mariana* (Mill.) BSP.

Melampsoropsis abietina (A. & S.) Arthur. Teliospores from *Ledum groendlandicum* Oeder infected *Picea rubra* (DuRoi) Dietr.

Uromyces Scirpi Burr. Teliospores from *Scirpus campestris* var. *paludosus* (A. Nelson) Fernald infected *Cicuta maculata* L.

Uromyces Peckianus Farl. Teliospores from *Distichlis spicata* (L.) Greene infected *Atriplex hastata* L., *Chenopodium album* L. and *Salicornia europea* L.

Uromyces perigynius Halst. Teliospores from *Carex deflexa* Hornem. infected *Solidago bicolor* L. Teliospores from *Carex scoparia* Schkuhr. infected *Solidago graminifolia* (L.) Salisb., and also *Aster* (*puniceus?*).

Puccinia perplexans Plow. Teliospores from *Alopecurus pratensis* L. infected *Ranunculus acris* L.

Puccinia albiperidia Arth. Teliospores from *Carex intumescens* Rudge, *Carex debilis* var. *Rudgei* Bailey, and *Carex crinita* Lam. infected *Ribes prostratum* L'Hér and teliospores from *Carex crinita* Lam. and *Carex arctata* Boot. infected *Ribes oxyacanthoides* L.

Puccinia Caricis-solidaginis Arth. Teliospores from *Carex scoparia* Schkuhr. infected *Solidago graminifolia* (L.) Salisb. and from *Carex stipata* Muhl. infected *Solidago* (*rugosa?*).

Puccinia Caricis-Asteris Arthur. Teliospores from *Carex trisperma* L. infected *Aster acuminatus* Michx.

2. *Life histories worked out for the first time*

Necium Farlowii Arth. Teliospores from *Tsuga canadensis* (L.) Carr. infected the same species.

Melampsoropsis Pyrolae (DC.) Arth. Teliospores from *Pyrola Americana* Sweet and *Pyrola elliptica* Nutt. infected cones of *Picea mariana* (Mill.) BSP. and *Picea canadensis* (Mill.) BSP. (*Peridermium conorum-Piceae* (Rees) Arthur).

Pucciniastrum minimum (Schw.) Arthur. Teliospores from *Rhodora canadense* (L.) BSP. infected leaves and cones of *Tsuga canadensis* (L.) Carr. (*Peridermium Peckii* Thüm.).

Uromyces Spartinae Farl. Teliospores from *Spartina Michauxiana* Hitch. infected *Arenaria lateriflora* L. but failed to infect *Spergularia canadensis* (Pers.) Don. Teliospores from *Spartina patens* (Ait.) Muhl. and *Spartina glabra* var. *alterniflora* (Loisel) Merr. infected *Spergularia canadensis* but failed to infect *Arenaria lateriflora* L.

Melampsora arctica Rostr. Teliospores from *Salix discolor* Muhl. infected *Abies balsamea* (L.) Mill.

Melampsora (*Medusae* Thüm.?) Teliospores from *Populus grandidentata* Michx. infected *Tsuga canadensis* (L.) Carr. (*Caeoma Abietis-canadensis* Farl.).

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CORRELATION BETWEEN CERTAIN SPECIES OF PUCCINIA AND UROMYCES[1]

C. R. Orton

(With Plates 70 and 71, Containing 12 Figures)

There are many interesting taxonomic problems which have arisen in the work of preparing the Uredinales for North American Flora. One of these problems, which has been supplemented somewhat by cultures and field observations, bears directly upon the relationship existing between *Puccinia* and *Uromyces*. To bring out one feature of this relationship more clearly than heretofore presented the writer has prepared this paper, pointing out certain species in the two genera which are conspicuous because of their apparent morphological similarity and of their occurrence upon the same or closely related hosts in both gametophytic and sporophytic stages. The similar geographical distribution of these correlated species appears in most cases to afford some additional support to this relationship.

A brief statement of the treatment of *Uromyces* and *Puccinia* by the leading workers on the rusts, from Persoon's time to the present, is here included for the purpose of a better understanding of the taxonomic development of these genera.

Persoon in 1794[2] was the first to publish any clearly defined work on fungi in which the Uredinales were included. In this work he brought forward the name *Puccinia,* a name first used by Micheli, a prebinomial author, and applied it to species of *Phragmidium* and those of other genera including three species of *Puccinia* as we now use that genus. In the same work the genus *Uredo* was established which contained four species now referable to as many genera. The second species was *Uredo Fabae* which is undoubtedly a *Uromyces.* In a later work[3] by the same

[1] Read before the American Phytopathological Society at the Washington meeting, Dec. 28, 1911.

[2] Neues Mag. Bot. 1: 93. 1794.

[3] Syn. Fung. 1: 220–230. 1801.

author there were three species now referable to the genus *Puccinia* included under that genus along with species representing at least three other genera, and under *Nigredo,* a name which he established as a subgenus of *Uredo,* there were several species which would now be referred to *Uromyces.*

The principal workers who followed Persoon were Schumacher in 1803, Willdenow in 1804, and DeCandolle in 1805. The last author made a slight variation from Persoon's classification in his admirable systematic work on the French flora.[4] He divided the genus *Puccinia* into three sections, the first of which included several species of *Phragmidium.* The second section contained 13 species, the majority of which are referable to *Puccinia* as now used. Under the third section, which he characterized as being similar to *Puccinia* but having one-celled spores, six species were listed all of which are now referred to *Uromyces.*

After DeCandolle came Link, who in 1809[5] established the genus *Caeoma* corresponding to *Uredo* of Persoon. It was divided into five sub-genera. Under the sub-genus *Caeomurus* he placed DeCandolle's third section of *Puccinia* with one-celled spores, now properly referred to *Uromyces.* In 1816[6] Link separated the genus *Phragmidium* from *Puccinia* under which it had been previously included and left under *Puccinia* several species now properly referred to this genus. In this same work *Caeoma* was changed to *Hypodermium* and *Caeomurus* to *Uromyces* but their generic relation to each other remained as in 1809. In 1825[7] he published his third important contribution, in which the rusts were classified under several genera which included *Caeoma, Puccinia, Triphragmium, Phragmidium, Podisoma,* and *Gymnosporangium.* There were 48 species listed under *Puccinia,* practically all of which are now referable to that genus. *Caeoma* was divided into four sub-genera, namely: *Uredo, Aecidium, Ceratitium* and *Peridermium.* The first contained 113 species many of which were probably in the uredinial stage. There appears to be no disposition of species belonging to *Uromyces* except under this sub-genus.

[4] Flora Francaise 2: 218–236. 1805.
[5] Ges. Nat. Freunde Berlin Mag. 3: 6. 1809.
[6] Ges. Nat. Freunde Berlin Mag. 7: 28–30. 1816.
[7] Willd. Sp. Plant. 6^2. 1825.

Link's 1816 classification was followed by Nees in 1817 and by S. F. Gray in 1821. Later came a series of authors, Schweinitz, Wahlenberg, Castagne, Léveillé and the Tulasnes, who in their disposition of *Uromyces* followed the methods of no one author but who endeavored to follow the combined good points of Persoon, DeCandolle and Link, which resulted in general confusion.

It remained for Fries,[8] the "Father of Mycology," to take up in 1846 the name *Uromyces,* which had been technically established as a genus by Unger[9] in 1833, and to place it in its present generic use. He made the noteworthy statement "Plurimae Pucciniae analogae respondent," a fact which none of the later urediniologists have refuted, and one which touches closely upon the subject of this paper. Schroeter[10] clearly brings out this analogous relation when he divides the genus *Uromyces* into biologic forms as eu-, brachy-, -opsis, micro-, and lepto-, in exactly the same manner as he did with the genus *Puccinia.*

Magnus[11] has called attention to the close morphological relationship existing between *Puccinia* and *Uromyces* on species of *Rumex* and has shown that in these species the urediniospores of the two genera intergrade in size and germ-pore characters on different species of host plant so that it is difficult to separate them in the uredinial generation.

Fischer in 1904[12] pointed out that a closer relationship existed between certain species of the genera *Puccinia* and *Uromyces* than existed in either genus alone, a fact which Arthur also observed and commented on in his "Classsification of the Uredinales."[13] Later in an article on "Reasons for Desiring a better Classification of the Uredinales"[14] Arthur calls them "parallel genera" differing only in the technical character of their teliospores.

McAlpine in his fine work on "The Rusts of Australia"[15] in speaking of *Puccinia* says: "The presence of mesospores in a

[8] Summa Veg. Scand. 1: 514. 1846.

[9] Exanth. Pfl. 277. 1833.

[10] Abh. Schles. Ges. 48: 8–11. 1869. Schroeter in Cohn, Krypt. Flora Schles. 3[1]: 229–313. 1887.

[11] Abh. Bot. Brand. 38: 11–14. 1896.

[12] Beitr. Krypt. Schweiz. 2[2]: xlvi. 1904.

[13] Result. Sci. Congr. Bot. Vienne 334. 1906.

[14] Jour. Myc. 12: 150–151. 1906.

[15] The Rusts of Australia 26. 1906.

species would seem to indicate its still close relationship to *Uromyces*, and that its separation from the parent form has not yet proceeded sufficiently far to obliterate every trace of its former connexion."

Hariot in his "Les Uredinees"[16] says that the autonomy of *Uromyces* is a difficult question and that if it is to be kept as a distinct genus it is only in order to follow the custom and to facilitate determinations. This statement seems very much to the point, but the author does, however, treat the two genera as distinct in this work.

P. & H. Sydow in their monograph of *Uromyces*[17] state that the genus differs from *Puccinia* only in the number of cells in the teliospore, and they cite several comparative examples of both the gametophytic and sporophytic generations of the two genera to show this similarity.

It is seen, then, that the name *Puccinia* was first applied to a *Gymnosporangium* by Micheli, was later applied by Persoon to *Phragmidium* with which a few species of *Puccinia* were included, and was in 1816 separated by Link from *Phragmidium* and made a genus as we now use it.

The species of rusts now referable to the genus *Uromyces* were first included by Persoon and his followers under *Uredo*. Later it was included as a sub-genus of *Puccinia* by DeCandolle, and was finally established technically as a genus by Unger in 1833 and put into general use by Fries in 1846. Since Fries' work all uredinologists have treated it as a distinct genus differing from *Puccinia* especially in its teliosporic character.

The present paper is what the writer believes to be the first attempt to list the correlated species in *Puccinia* and *Uromyces* and is limited to a discussion of a few of the more prominent types of correlation in the long-cycle forms only.

The writer acknowledges the generous aid and counsel of Dr. J. C. Arthur, without which the work would be impossible, and grateful thanks are due Dr. F. D. Kern for many helpful suggestions.

The first example to attract special attention was furnished by

[16] Les Urédinées 20. 1908.

[17] Monog. Ured. 2: vi–xi. 1909.

Mr. W. P. Fraser[18] of Pictou, Nova Scotia, when he made sowings in the spring of 1910 of teliospores of *Uromyces Peckianus* Farlow on *Atriplex patula* and *Chenopodium album,* both of which produced infection and formed aecia of the same type as those of *Puccinia subnitens* Diet. on the same hosts. This extremely interesting result led to a careful comparison of the two rusts with results as follows: *Puccinia subnitens* Diet., is a rust on *Distichlis spictata* (L.) Greene and has its aecia on a large number of Chenopodiaceous, Capparidaceous and Cruciferous hosts,[19] which include *Atriplex, Beta, Cleome, Capsella, Chenopodium, Lepidium, Sarcobatus,* etc. The aecia are grouped and have erect peridia with peridial cells rhomboidal and in radial sections much thickened in the outer wall. On comparing the aecia of *Uromyces Peckianus* it was found that they were identical in all discernible morphological characters. The chief interest, however, lies in a comparison of the urediniospores, the morphology of which has been of greatest use in the study of the grass and sedge rusts. The urediniospores of *Puccinia subnitens* measure 18–24 by 19–26 μ, are pale cinnamon-brown with a wall about 2 μ thick, very finely verrucose, the pores 6, scattered. The urediniospores of *Uromyces Peckianus* measure 16–21 by 18–24 μ, are pale cinnamon-brown with a wall about 2.5 μ thick, very finely verrucose, and have 6 scattered pores. The teliospores of the two rusts possess no differential characters except, of course, number of cells and consequent size.

The distribution of the two is interesting. The telial host of both, *Distichlis spicata* (L.) Greene, grows in salt marshes on the Atlantic and Pacific coasts and in saline soil in the interior. *Uromyces Peckianus* is known only from the coastal regions while *Puccinia subnitens* on the other hand is an interior form having been collected at only one point on the coast and that at Lewes, Delaware. The reason for this is speculative at present, but it seems probable that the one-celled form is less adaptive to varying conditions of soil and temperature than the two-celled form and so has thus far been unable to thrive in the interior.

[18] Mycologia 3: 72–74. 1911.

[19] Bot. Gaz. 35: 19. 1903; Jour. Myc. 11: 55. 1905; 12: 16. 1906; 13: 197. 1907; 14: 15. 1908; Mycologia 1: 234. 1909; 2: 225, 1910: 4: 18. 1912; 4: 54. 1912.

The next species to attract particular attention and which are undoubtedly correlated are a *Puccinia* passing under several names (*P. Caricis-Asteris, P. Caricis-Solidaginis, P. Caricis-erigerontis*) on various species of *Carex,* having aecia on *Aster, Solidago, Erigeron,* and close relatives,[20] and *Uromyces perigynius* Hals. (*U. caricina* E. & E.) on several species of *Carex* which is known to have its aecia on *Solidago* and *Aster.*[21] The aecia of the two species appear identical and a careful microscopical study reveals that the peridial cells and aeciospores cannot be differentiated. The urediniospores of the *Puccinia* measure 14–19 by 18–24 μ, are light cinnamon-brown with a wall about 1.5 μ thick, moderately echinulate and have 2 superequatorial pores. A comparison of the urediniospores of *Uromyces perigynius* shows that they are identical in all their characters with the *Puccinia* form. The teliospores of the two species also possess identical characters except number of cells, having thin walls and rather thick apices. The distribution of the two is practically the same, extending across the northern half of the United States and into Canada. Three of the telial hosts, *Carex intumescens* Rudge, *C. scoparia* Schk., and *C. tribuloides* Wahl. are the same for both species.

A rust on species of *Andropogon, Puccinia Ellisiana* Thüm., has been in cultures[22] four different years on various hosts without success. It is a form widely distributed throughout the United States east of the Rocky mountains and in Mexico, and had puzzled us much until Dr. J. F. Brenckle, of Kulm, North Dakota, wrote on June 5, 1911, that he had found aecia on *Viola* near *Puccinia Ellisiana.* In a later communication he mentioned evidence to verify this probable connection. The suggestion seems very likely for in the Arthur Herbarium there are collections of aecia on *Viola* within the range of this rust which are out of the range of the *Uromyces* on *Andropogon* and which have peridial cells and aeciospores that are clearly differentiated, when carefully compared microscopically, from the autoecious rusts on *Viola.* On a careful study of *Puccinia Ellisiana* we find that

[20] Jour. Myc. 8: 53–54. 1902; Bot. Gaz. 35: 15, 21. 1903; Jour. Myc. 11: 58. 1905; 12: 15. 1906; 14: 13. 1908; Mycologia 1: 233. 1909; 2: 224. 1910.

[21] Mycologia 4: 21. 1912.

[22] Jour. Myc. 14: 10. 1908; Mycologia 1: 231. 1909; 2: 220. 1910; 4: 9. 1912.

it is apparently correlated with *Uromyces pedatatus* (Schw.) Sheldon. It has urediniospores which measure 18–20 by 19–23 μ, with walls about 3 μ thick, usually slightly thicker above, very finely and closely verrucose-echinulate, and have 4 or sometimes 3 equatorial pores. The urediniospores of *Uromyces pedatatus* possess no differential characters from those of *Puccinia Ellisiana* and have the same number and arrangement of pores. The teliospores of the two have the same general shape and wall thickness and so we venture to predict that Dr. Brenckle's observations are entirely correct and that *P. Ellisiana* has *Viola* for its aecial host.[23] The telial hosts of *Uromyces pedatatus* are restricted so far to *Andropogon glomeratus* (Walt.) BSP. and *A. virginicus* L. with a range extending from the Atlantic coast to Arkansas and southward, while the telial hosts of *Puccinia Ellisiana* include in addition to those of *U. pedatatus, Andropogon furcatus* Muhl. and *A. scoparius* Michx. with practically the same southern range but extending further north into North Dakota and west to Colorado. Here we see the greater adaptability of the two-celled form in a wider range of hosts and distribution.

In 1901, Dr. Arthur[24] connected a rust on *Carex pubescens* with an aecium on *Ribes Cynosbati* L. which possessed in culture a white or very pale peridium in contrast to the usual orange-colored aecial forms on various species of currants and gooseberries. He named the rust *Puccinia albiperidia.* In 1910 it was found that the original telial host as well as several other telial hosts represented in the herbarium, part having been reported in cultures,[25] possessed urediniospores with the marked morphological character of one basal pore, and it was decided that *P. albiperidia* was a good morphological species having its aecia on *Ribes* spp. Very recently, however, it has been found that in the type material and in every case where the species has been cultured on *Ribes* urediniospores in more or less abundance could be found which were morphologically identical with the urediniospores of the common gooseberry-currant rust of Europe and America.

[23] Since the writing of this paper it has been communicated to the writer through Dr. F. D. Kern that Mr. W. H. Long reports having cultured a *Puccinia* from *Andropogon* upon *Viola.* Doubtless this was *Puccinia Ellisiana.*

[24] Jour. Myc. 8: 53. 1902.

[25] Jour. Myc. 10: 11. 1904; Mycologia 4: 13. 1912.

This discovery has led to the conclusion that the common form has been responsible for the successful cultures upon *Ribes* of this particular rust bearing the name *P. albiperidia* and that the rust having urediniospores with one basal pore is an unconnected form without a name. In order to discuss more readily this particular species I hereby propose the following name for it:

Puccinia uniporula sp. nov.

Urediniospores broadly ellipsoid, 16–23 by 25–29 μ, wall 1.5–2 μ thick, with only one pore placed near the hilum. Telia hypophyllous, scattered, roundish or oblong, 0.2–0.7 mm. long, early naked, pulvinate, dark cinnamon-brown. Teliospores broadly clavate, 15–20 by 34–48 μ, apex thickened up to 10 μ. Pedicel about once the length of spore or less.

The type is on *Carex pubescens* Muhl., collected at London, Canada, August 20, 1910, by J. Dearness. It has also been detected on six other species of *Carex*, and occurs sparingly from Newfoundland to Iowa.

In 1910, Dr. F. D. Kern[26] published the species *Uromyces uniporulus* on *Carex tenuis*, which has broadly ellipsoid urediniospores measuring 18–21 by 21–26 μ, with cinnamon-brown walls about 1.5 μ thick, rather sparsely and distinctly echinulate, and having one basal pore. The telial hosts of this rust are *Carex gracillima* Schw. and *C. tenuis* Rudge, both of which are hosts of *Puccinia uniporula*. The distribution of this species is now known locally from the New England states to Wisconsin. The aecial host of *Uromyces uniporulus* is unknown but it is undoubtedly the same as that of *Puccinia uniporula*.

The rusts on *Spartina* have been studied considerably in the past and three forms of *Uromyces* which variously intergrade have been separated, having aecia on members of the *Caryophyllaceae, Primulaceae,* and *Polemoniaceae* respectively.[27] The form of *Uromyces acuminatus* Arth., having aecia on *Steironema ciliatum* (L.) Raf. and telia on *Spartina gracilis* Trin. and *S. Michauxiana* Hitch. possesses urediniospores which are globoid, meas-

[26] Rhodora 12: 125. 1910.

[27] Jour. Myc. 12: 24. 1906; 13: 193. 1907; 14: 17. 1908; Mycologia 2: 221. 1910; 4: 29. 1912.

uring 23–26 by 26–30 μ, wall golden-yellow, 2–3 μ thick, very finely and sparsely echinulate, the pores being 8 scattered. *Puccinia Distichlidis* E. & E. was erroneously described as on *Distichlis maritima* Raf., the host being *Spartina gracilis* Trin. This rust has urediniospores whach are globoid, measuring 23–26 by 26–30 μ are golden-yellow with a wall 3–3.5 μ thick, very finely and sparsely echinulate, the pores being 8 scattered. The teliospores of the two rusts possess the close resemblanc of correlated forms. The distribution of the two-celled form extends from Iowa northwest to Wyoming and Montana, and of the one-celled form from Illinois west to Colorado and north to Alberta. The telial hosts of the two forms are the same. *Puccinia Distichlidis* has been cultured[28] on 21 different aecial hosts without success but not on the aecial host of *Uromyces acuminatus*. It seems, therefore, extremely probable that its aecial host is on some member of the primrose family, perhaps *Steironema,* or some member of the phlox family, but more likely the former.

Another evident case of correlation exists between *Puccinia Pammellii* (Trel.) Arth. and *Uromyces graminicola* Burr. In 1904, Dr. Arthur reported the cultures[29] of *Puccinia Panici* Diet. as the rust on *Panicum virgatum* was then called, upon *Euphorbia corollata* L. This rust has globoid urediniospores, measuring 19–23 by 21–24 μ, with a light cinnamon-brown wall about 2 μ thick, finely verrucose-echinulate, the pores are 3 or 4, usually approximately equatorial, but often scattered. The teliospores are small, somewhat thickened and rounded above.

Uromyces graminicola Burr. also on *Panicum virgatum* L. has been cultured[30] on 19 various hosts without success but never on *Euphorbia* to the writer's knowledge. It has globoid urediniospores measuring 15–19 by 18–23 μ which have all their other characters identical with those of *Puccinia Pammellii.* The teliospores of these forms have the same morphological resemblance which is expected in correlated species. *Puccinia Pammellii* has a distribution from Pennsylvania west to Nebraska and south to the Gulf of Mexico and *Uromyces graminicola* has practically the

[28] Mycologia 2: 219, 1910; 4: 11, 1912.
[29] Jour. Myc. 11: 56. 1905.
[30] Jour. Myc. 12: 13. 1906; Mycologia 1: 232. 1909; 4: 12. 1912.

same distribution. It seems very probable, therefore, that this one-celled form has aecia of the same character as those connected with *Puccinia Pammellii* and on an upright form of *Euphorbia.*

Several other examples have been observed which have for their telial hosts identical or closely related species of the same genus, only a mention of which is made here. Among the heteroecious forms the following have been noted:

1. *Puccinia Eleocharidis* Arth. with *Uromyces Eleocharidis* Arth., both on *Eleocharis* spp., the *Puccinia* having aecia on *Eupatorium perfoliatum.*

2. *Puccinia angustatoides* Stone with *Uromyces Rhynchosporae* Ell., both on *Rhynchospora* spp.

The following autoecious species present the same striking correlation in all their spore forms as do the heteroecious species:

1. *Puccinia heterantha* Ell. & Ev. with *Uromyces plumbarius* Peck, both on several representatives of the Onagraceae.

2. *Puccinia Gentianae* (Str.) Link with *Uromyces speciosus* Holw. on *Gentiana* spp.

3. *Puccinia Ruelliae-Bourgaei* Diet. & Holw. with *Uromyces Ruelliae* Holw. on *Ruellia* spp.

4. *Puccinia opaca* Diet. & Holw. with *Uromyces cucullatus* Sydow both on *Zexmenia* spp.

There are a few slight comparative differences worthy to be noted in a careful study of these correlated species. From a comparison of accurate measurements of a large number of urediniospores it is found that those of the *Puccinia* species are usually slightly larger and have thicker walls than those of the correlated *Uromyces* form. There is also sometimes noticed a marked difference in the vigor of the two forms, the *Puccinia* being the more vigorous in its attack upon the host plant. These differences, however, only mean that the genus *Puccinia* has a greater adaptability to environmental conditions and seems better fitted to survive than the less vigorous form. This is also brought out in the preponderance in numbers of species in the genus *Puccinia* as compared to the number in the genus *Uromyces.*

There are many correlated species among the long-cycle forms of *Puccinia* and *Uromyces* which are not mentioned in this paper.

Many southern and western species are but imperfectly understood and lack of time has prevented a careful study of some of the forms already fairly well known. It should not be inferred that every species of *Puccinia* has a correlated form in *Uromyces.* Correlation does occur frequently however, and appears not to be confined to any particular family or order of hosts, although it seems to be most common on the grasses and sedges. The reasons for these limitations appear to lie in a solution of the conditions surrounding the evolution of the rusts and their hosts, and any knowledge concerning the evolution of host and parasite undoubtedly has a close bearing upon the solution of this phase of the problem.

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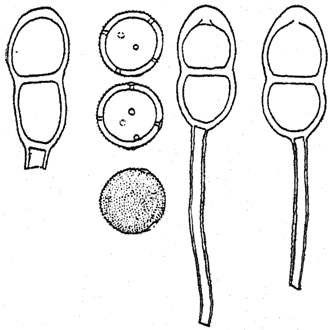
EXPLANATION OF PLATES LXX AND LXXI

The drawings were outlined with the camera lucida at a uniform scale, the reproductions representing approximately 470 diameters. In all cases the urediniospores are represented with the hilum, or attachment of pedicel, below. The urediniospores are drawn to show thickness of wall, surface markings and position and number of germ pores. The teliospores are drawn to show thickness of wall and apex, and the average length of pedicel.

Fig. 1. *Puccinia subnitens* on *Distichlis spicata.*
Fig. 2. *Uromyces Peckianus* on *Distichlis spicata.*
Fig. 3. *Puccinia Caricis-Asteris* on *Carex tribuloides.*
Fig. 4. *Uromyces perigynius* on *Carex intumescens.*
Fig. 5. *Puccinia Ellisiana* on *Andropogon furcatus.*
Fig. 6. *Uromyces pedatatus* on *Andropogon virginicus.*
Fig. 7. *Puccinia uniporula* on *Carex pubescens.*
Fig. 8. *Uromyces uniporulus* on *Carex gracillima.*
Fig. 9. *Puccinia Distichlidis* on *Spartina gracilis.*
Fig. 10. *Uromyces acuminatus* on *Spartina gracilis.*
Fig. 11. *Puccinia Pammellii* on *Panicum virgatum.*
Fig. 12. *Uromyces graminicola* on *Panicum virgatum.*



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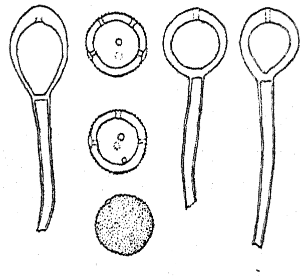

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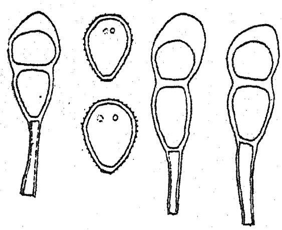

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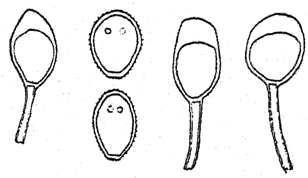

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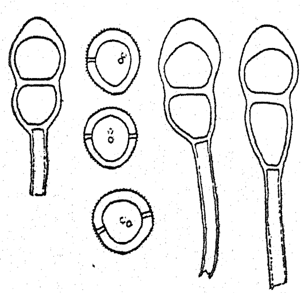

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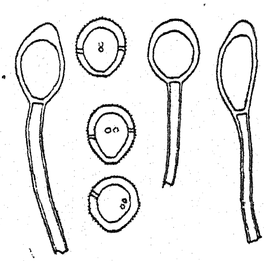
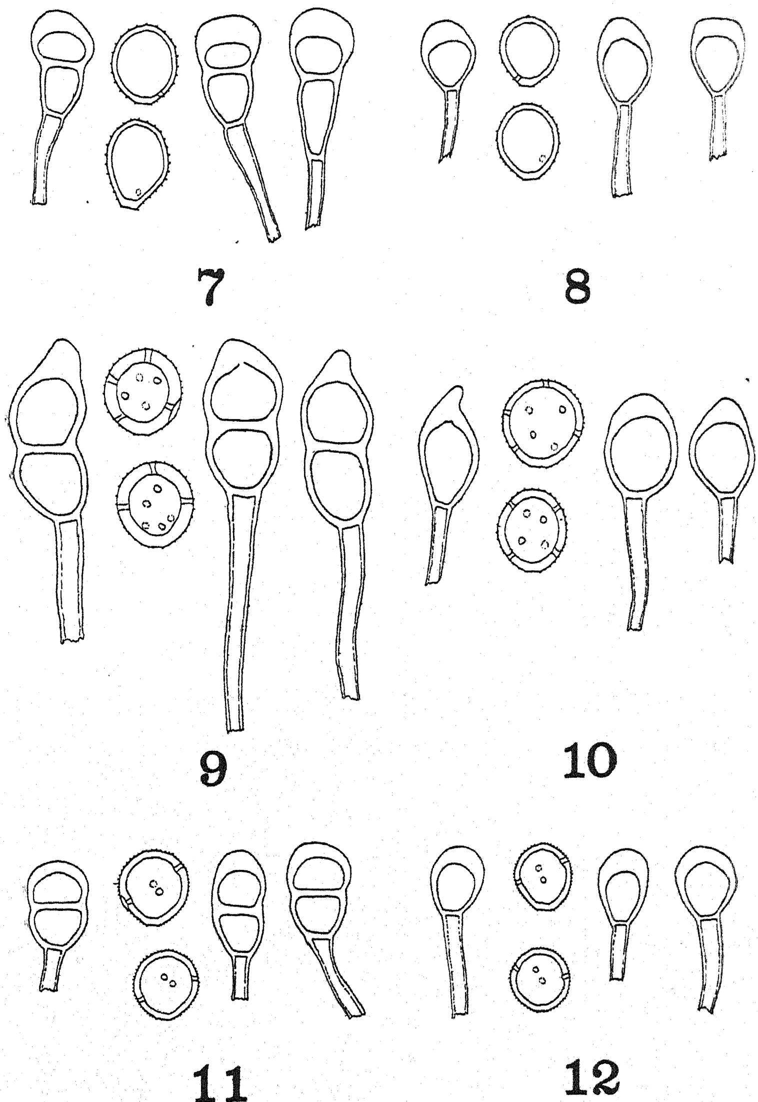


6

SPORES OF PUCCINIA AND UROMYCES



SFORES OF PUCCINIA AND UROMYCES

THE AGARICACEAE OF THE PACIFIC COAST—I

William A. Murrill

A list of the pileate polypores and boletes collected by the writer on the Pacific coast in 1911 appeared in Mycologia for March, 1912, together with a descriptive list of the localities visited at that time. The present series of articles is more comprehensive in scope, including all the gill-fungi known to exist in California, Oregon, Washington, British Columbia, and Alaska, as represented in the collections of McClatchie, Dudley, Trelease, Baker, Abrams, Harper, McMurphy, M. E. Peck, Lake, Zeller, and others. Naturally, the extensive collections and field studies made by the writer in 1911 will be used as the basis of these articles.

The Pacific Coast is the fifth distinct region in which the writer has been interested so far as the fleshy fungi are concerned. The northeastern United States have many species in common with Europe and a fair knowledge of European species is necessary to the student of this section. Also, a number of prevailing types circle the globe in temperate regions and extend southward along the mountains. The southern United States show a large number of distinct species which may well be studied as a group, although northern species are not rare and some tropical species occur there. As already stated in previous articles, the gap between tropical and temperate American species is comparatively wide and abrupt, although a few northern species are to be expected in the high mountains of our tropical islands, probably owing to former connections with the mainland.

The region of the Pacific coast is of exceeding interest, and has been so during recent geologic time, since the differentiation of the seasons. It differs more from the eastern United States in many respects than the eastern United States differ from northern Europe, which is explained by former land connections with Europe by way of Greenland. The difference in the fungi is not

that abrupt one noticed in the change to tropical America, where important temperate genera are wholly lacking, but it is rather a case of the same or similar genera represented largely by different species from those found east of the Rocky Mountains.

Tribe CHANTERELEAE

1. DICTYOLUS Quél. Ench. Fung. 139. 1886

DICTYOLUS RETIRUGUS (Bull.) Quél. Ench. Fung. 140. 1886

Chanterel bryophilus Peck, Harriman Alaska Exp. Crypt. 46. 1904. Not *C. bryophilus* Fries, Syst. Myc. **1**: 325. 1821.

Muir Glacier, Alaska, *Trelease 552, 563;* Stanford University, California, *Baker.*

2. CHANTEREL Adans. Fam. Pl. **2**: 11. 1763

1. CHANTEREL BEHRINGENSIS Berk. & Curt. Proc. Am. Acad. **4**: 119. 1858

Bering Strait, Alaska, *Wright.*

2. CHANTEREL INFUNDIBULIFORMIS (Scop.) Fries, Epicr. Myc. 366. 1838

This species was found to grow very abundantly most of the year in a peat bog in the vicinity of Seattle among sphagnum and cranberry. The pileus is avellaneous and the stipe dull-luteous in fresh plants.

Seattle, Washington, *Murrill 273.*

3. CHANTEREL FLOCCOSUS Schw. Trans. Am. Phil. Soc. II. **4**: 153. 1832

Corvallis, Oregon, *Murrill 1014;* Salem, Oregon, *M. E. Peck.*

4. CHANTEREL ALECTOROLOPHOIDES (Schaeff.) Murrill, N. Am. Fl. **9**: 169. 1910

Seattle, Washington, *Murrill 669, Zeller;* La Honda, California, *Murrill & Abrams 1276;* British Columbia, *A. I. Hill 62.*

5. CHANTEREL CHANTARELLUS (L.) Murrill, N. Am. Fl. 9: 169. 1910

I found it difficult to believe that this was the same plant I had seen so often in Europe and the eastern United States. It grows much larger, is often compound and proliferous, and the hymenium becomes exceedingly complicated as it develops. The flesh is white and mild to the taste, and is very probably edible. Its size and abundance should make it an important article of food if it proves to be as wholesome as the eastern form.

Seattle, Washington, *Murrill 294, 363, 677, Zeller 1;* Corvallis, Oregon, *Murrill 1024,* Newport, Oregon, *Murrill 1026, 1050;* Berkeley, California, *Harper 5*, Stanford University, California, *Nohara 59*, Searsville Lake, California, *McMurphy 34*.

Tribe LACTARIEAE

This tribe, containing the genera *Russula* and *Lactaria,* will be treated in a separate article by Dr. Gertrude S. Burlingham.

Tribe AGARICEAE

Sporophore terrestrial, rarely wood-loving, fleshy throughout, centrally stipitate; spores white.	
Lamellae waxy at maturity, translucent or watery in appearance.	
Veil absent; pileus usually bright-colored.	1. HYDROCYBE.
Veil present; pileus rarely bright-colored.	2. HYGROPHORUS.
Lamellae not waxy, but having that appearance.	3. LACCARIA.
Lamellae neither waxy nor appearing waxy; veil present.	
Lamellae adnate.	4. ARMILLARIA.
Lamellae free.	5. LIMACELLA.
Sporophore wood-loving, with stipe eccentric, lateral, or wanting; spores white.	
Lamellae split longitudinally.	6. HYPONEVRIS.
Lamellae not split.	
Pileus sessile, tough, reviving, with a gelatinous upper stratum.	7. RESUPINATUS.
Pileus fleshy, not reviving, context homogeneous.	
Pileus dimidiate or resupinate.	8. GEOPETALUM.
Pileus stipitate.	
Veil wanting.	9. CREPIDOPUS.
Veil present.	10. PLEUROTUS.

1. HYDROCYBE (Fries) Karst. Hattsv. 233. 1879

1. HYDROCYBE CONICA (Scop.) Karst. Hattsv. 236. 1879

Abundant among mosses in open coniferous barrens about Seattle. All stages of color were observed from miniatous or

orange to greenish and blackish, becoming darker on drying. In Oregon, plants were found over 13 cm. high.

Seattle, Washington, *Murrill 520,* Tacoma, Washington, *Murrill 724;* Mill City, Oregon, *Murrill 795;* Portola, California, *McMurphy 55;* British Columbia, *A. I. Hill 16, 53.*

2. HYDROCYBE COCCINEA (Schaeff.) Karst. Hattsv. 234. 1879

Hygrophorus coccineus (Schaeff.) Fries, Epicr. Myc. 330. 1838.

Determined by Harper from fresh material. Spores ellipsoid, papillate at the side of the base where attached, hyaline with a slightly yellowish tint, 8–10 × 5–6 μ.

Muir Woods, California, *Harper 61;* Kings Mountain, California, under redwoods, *Dudley 164.*

3. **Hydrocybe constans** sp. nov.

Pileus convex, slightly umbilicate, gregarious, 1.5 cm. broad; surface glabrous, shining, not viscid, uniformly red, unchanging on drying, striate from the margin half way to the center; lamellae adnate with decurrent tooth, rather distant, plane or arcuate, testaceous-flavous; spores ellipsoid, smooth, hyaline, 7 × 4 μ; stipe hollow, subequal, smooth, glabrous, concolorous above, ochraceous at the base, 7 cm. long, 5 mm. thick.

Type collected in moss in low woods at Mill City, Oregon, November 9, 1911, *W. A. Murrill 814.* This species resembles *Hygrophorus miniatus* Fries in its form and brilliant red coloring, but does not fade on drying.

4. **Hydrocybe arenicola** sp. nov.

Pileus convex to slightly depressed, gregarious, reaching 7.5 cm. broad; surface sticky but not slimy, smooth, glabrous, melleous, with a ferruginous-ochraceous tint as the plants become older, usually blackish at the center; lamellae short-decurrent, arcuate to plane, venose-connected, distant, thin, whitish to cremeous, flavous on drying; spores ovoid, tapering at one end, smooth, hyaline, 7 × 4 μ; stipe subequal, sticky, smooth, glabrous, pale-melleous, hollow, 5 cm. long, 1.5 cm. thick.

Type collected on the ground in sandy pine barrens on the immediate coast at Newport, Oregon, November 13, 1911, *W. A. Murrill 1049.*

5. **Hydrocybe cremicolor** sp. nov.

Pileus convex to expanded, umbonate, solitary, 2.5 cm. broad; surface moist, not viscid, glabrous, smooth, uniformly cream-colored; lamellae decurrent, arcuate, distant, bright yellowish-white; spores ovoid, pointed at one end, smooth, hyaline, $5–6 \times 3.5–4\,\mu$; stipe fleshy, subequal, smooth, glabrous, cremeous, 5 cm. long, 7 mm. thick.

Type collected on the ground in woods at Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 568*. Plants collected at Berkeley, California, *Harper 30*, appear to agree with this species in the main, but are 4 cm. broad, slightly depressed, and the spores are ovoid, not pointed, $7 \times 4\,\mu$.

2. HYGROPHORUS Fries, Gen. Hymen. 8. 1836

1. HYGROPHORUS EBURNEUS (Bull.) Fries, Epicr. Myc. 321. 1838.

One of the most common and abundant species on the Pacific coast. In many localities, I could have gathered a basketful in a very small area. It is edible, and may be recognized by its white color, slimy covering, mild odor, and decurrent, distant gills.

Mill City, Oregon, *Murrill 832*, Corvallis, Oregon, *Murrill 887*, Salem, Oregon, *M. E. Peck;* Marin Co., California, *Miss Eastwood*, Mt. Tamalpais, California, *Miss Eastwood*, Berkeley, California, *Harper 18*, Stanford University, California, *McMurphy 139*, *Baker 138*, Searsville Lake, California, *McMurphy 58*.

2. **Hygrophorus variicolor** sp. nov.

Pileus rather thick and fleshy, convex to nearly plane, sometimes umbonate, solitary, 5–12 cm. broad; surface smooth, the center moist, subviscid, and glabrous, the margin dry and hispid-scaly, color varying from fulvous at the center to ferruginous-fulvous between center and margin, and stramineous on a marginal zone 1–5 cm. broad; lamellae squarely adnate, somewhat decurrent in large plants, subdistant, inserted, white, waxy, changing to reddish-brown on drying; spores ovoid, smooth, hyaline, $6–8 \times 4–4.5\,\mu$; stipe fleshy, subequal, white, pulverulent, 4 cm. long, nearly 1 cm. thick; veil represented by a few short, brownish fibrils at the center of the stipe.

Type collected on the ground in low woods, near Mill City, Oregon, November 9, 1911, *W. A. Murrill 802*. Also collected

in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 352, 400, S. M. Zeller 12.* A very beautiful species, related to *Hygrophorus Laurae* Morgan.

3. **Hygrophorus fragrans** sp. nov.

Pileus convex to depressed, not umbonate, gregarious, decidedly fragrant when dry, 8–10 cm. broad; surface smooth, glabrous, viscid, roseous to incarnate, with white margin and somewhat darker center; context rather thick and fleshy, white; lamellae adnate, distant, inserted, white; spores ellipsoid, smooth, hyaline, averaging $8 \times 5\,\mu$; stipe long, equal, solid, furfuraceous, whitish to cremeous or ochraceous, punctate with reddish-brown dots in dried specimens and turning reddish-brown where handled, reaching 10 cm. long and 2 cm. thick.

Type collected in low coniferous woods near Corvallis, Oregon, November 6–11, 1911, *W. A. Murrill 1009.* The punctate stipe reminds one of *Hygrophorus rubropunctatus* Peck.

4. **Hygrophorus subpustulatus** sp. nov.

Pileus fleshy, rather thin, convex, obtusely umbonate when young, solitary or gregarious, 2.5–5 cm. broad; surface very viscid-slimy, especially when young, whitish-avellaneous, sometimes varying to white on the margin, smooth, glabrous; lamellae squarely adnate, rarely slightly decurrent, plane, distant, inserted, white; spores ovoid, smooth, hyaline, $7–8 \times 4–6\,\mu$; stipe white throughout, equal, pruinose above, stuffed, about 7 cm. long and 1 cm. thick.

Type collected on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 317.* Also collected on November 7, 1911, at Glen Brook, Oregon, *W. A. Murrill 777,* and on November 9, 1911, at Mill City, Oregon, *W. A. Murrill 861.* The plants listed under *Hygrophorus limacinus* in the report of the Harriman Alaska Expedition probably belong in this category, but I have not yet had an opportunity to examine them.

3. LACCARIA Berk. & Br. Ann. Nat. Hist. 370. 1883

1. LACCARIA LACCATA (Scop.) Berk. & Br. Ann. Nat. Hist. 370. 1883

Seattle, Washington, *Murrill 289, 503, 656, 711;* Corvallis, Oregon, *Murrill 889,* Newport, Oregon, *Murrill 1041;* La Honda, California, *Murrill & Abrams 1249,* Berkeley, California, *Harper,* Stanford University, California, *Dudley 153, 172, 180, Nohara 35, Miss Patterson 46;* British Columbia, *A. I. Hill 44, 50, 84, 93.*

2. LACCARIA OCHROPURPUREA (Berk. & Curt.) Peck, Ann. Rep. N. Y. State Mus. **50**: 129. 1897

Seattle, Washington, *Murrill 334,* Tacoma Prairies, Washington, *Murrill 717;* Stanford University, California, *Nohara 34, M. T. Cook 4; Abrams 210.*

4. ARMILLARIA (Fries) Quél. Champ. Jura Vosg. 36. 1872

1. ARMILLARIA MELLEA (Vahl) Quél. Champ. Jura Vosg. 36. 1872

Seattle, Washington, *Murrill 703;* Salem, Oregon, *M. E. Peck 5, 21;* Golden Gate Park, San Francisco, California, *Murrill 1102,* La Honda, California, *Murrill & Abrams 1283,* Santa Cruz Mountains, California, *Dudley 105,* Searsville Lake, California, *McMurphy 13, 21,* Madera Creek, California, *McMurphy 1, 17, 40;* Pomona, California, *Baker 3937.*

2. ARMILLARIA ALBOLANARIPES Atk. Ann. Myc. **6**: 54. 1908

A very handsome species described from specimens collected near Corvallis, Oregon, by E. R. Lake in 1906. The description is correct in the main, except that the stipe is solid.

Corvallis, Oregon, *Lake, Murrill 1006;* Glen Brook, Oregon, *Murrill 771;* Newport, Oregon, *Murrill 1047;* Searsville Lake, California, *McMurphy 120, 121.*

3. ARMILLARIA SUBANNULATA Peck, Bull. Torrey Club **36**: 330. 1909

Pileus thick, fleshy, convex or broadly convex, subviscid, fibrillose, alutaceous, darker in the center where it is adorned with

reddish-brown fibrils, margin even; flesh white, odor and taste farinaceous; lamellae close, adnexed, white, sometimes becoming brown on the edges; stem equal, solid, subradicating, reddish-brown, white at the top, veil thick, soft, white, evanescent; spores ellipsoid, $10–12 \times 8–9 \mu$.

Pileus 10–11 cm. broad; stem 9–15 cm. long, 2–3 cm. thick.

Described from specimens collected by Baker under oaks at Claremont, California. Types not seen.

4. **Armillaria arenicola** sp. nov.

Pileus firm, fleshy, convex to subplane or slightly depressed, gibbous, gregarious, 12–15 cm. broad; surface dry, smooth, glabrous, white or whitish, cremeous at the center; context coarse, white, tasteless; lamellae adnate, becoming sinuate-adnexed or nearly free, ventricose, plane, close, white, changing to rust-colored when bruised; spores globose, smooth, hyaline, $4–6 \mu$; stipe equal or tapering downward, dry, smooth below, somewhat scaly above the annulus, white tinged with cremeous, 12 cm. long, 3 cm. thick; annulus ample, persistent, membranous, white, attached just above the middle of the stipe.

Type collected in the sand hills among scrubby pines on the immediate coast at Newport, Oregon, November 13, 1911, *W. A. Murrill 1044*. A species remarkable for its size and habit of living in apparently pure sand, although the source of its food is doubtless buried humus. In general appearance, it resembles *Armillaria magnivelaris* Peck.

5. LIMACELLA Earle, Bull. N. Y. Bot. Gard. **5**: 447. 1909

1. **Limacella fulvodisca** (Peck)

Lepiota fulvodisca Peck, Bull. Torrey Club **22**: 198. 1895.

Described from specimens collected by McClatchie among leaves in woods near Pasadena, California, January, 1895.

Pasadena, California, *McClatchie;* Golden Gate Park, San Francisco, California, *Murrill 1101, 1105, 1112, 1119;* Stanford University, California, *Baker 159*.

2. **Limacella roseicremea** sp. nov.

Pileus convex to plane, with a broad umbo, slow to expand, solitary, 6 cm. broad; surface smooth, glabrous, viscid, cream-

colored tinted with rose, margin inflexed, not striate; context white, odor farinaceous; lamellæ free, rather close, arcuate, white; spores globose, smooth, corroded, apparently not maturing, white but not transparent, 4–5 μ; stipe subequal, enlarged at the base, white, fleshy, solid, smooth, glabrous, viscid, often very long, 5–10 $\times$ 0.8–1.2 cm.; veil ample, membranous, persistent, superior, remaining for some time stretched from margin to stipe.

Type collected on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 574*. Also collected in the region at the same time, *W. A. Murrill 534, 585*.

3. **Limacella McMurphyi** sp. nov.

Pileus fleshy, convex, solitary, 3.5–4 cm. broad; surface smooth, glabrous, evidently viscid when fresh, pinkish-cream-colored, not striate; context white, rather thick, with farinaceous taste and odor; lamellae free, crowded, inserted, ventricose, white; spores globose, smooth, hyaline, 3.5–4 μ; stipe slightly tapering upward, subglabrous, even, white, solid, 4–6 $\times$ 0.5–1 cm.; annulus superior, ample, persistent, white.

Type collected among leaves under redwoods near Searsville Lake, California, January 6, 1903, *James McMurphy 36*. The description is drawn from excellent field notes made by the collector. The species is distinguished from the preceding by its crowded, ventricose lamellae, and usually thicker stipe.

6. HYPONEVRIS Paulet, Icon. *pl. 1. f. 3–5.* 1812.

Schizophyllus Fries, Obs. Myc. **1**: 103. 1815.
Schizophyllum Fries, Syst. Myc. **1**: 330. 1821.

HYPONEVRIS ALNEUS (L.) Earle, Bull. N. Y. Bot. Gard. **5**: 412. 1909

Agaricus alneus L. Sp. Pl. 1176. 1753.
Agaricus multifidus Batsch, Elench. Fung. 173. *f. 126.* 1783.
Agaricus radiatus Sw. Prodr. 148. 1788. (Type from Jamaica.)
Schizophyllum commune Fries, Syst. Myc. **1**: 330. 1821.
Schizophyllum umbrinum Berk. Hook. Jour. Bot. **3**: 15. *pl. 1. f. 1.* 1851. (Type from Brazil.)
Schizophyllum fasciatum Pat. Jour. de Bot. **1**: 170. 1887. (Type from Mexico.)

Schizophyllum mexicanum Pat. Jour. de Bot. **1**: 171. 1887. (Type from Mexico.)

Schizophyllum Egelingianum Ellis & Ev. Bull. Torrey Club **22**: 439. 1895. (Type from Mexico.)

This species is one of the most common of all fungi, occurring on dead wood of various kinds in all lands. *Schizophyllum umbrinum* is a small, multifid, tropical form of this species, which appears much the same in all the collections at Paris and Kew, being represented there by specimens from Brazil, Surinam, French Guiana, Cuba, and Nicaragua. Specimens in the Ellis Herbarium from Nicaragua labeled *Schizophyllum multifidum digitatum* agree with this form. *S. pavonium,* from Mexico, in the Kew Herbarium, and *S. pusillum,* from Australia, at Upsala, are not distinct from *H. alneus,* and the description of *S. exiquum* Miq., from Surinam, leads one to believe that this also is a synonym. *Schizophyllum flabellare* Fries, a name occasionally assigned to American material, applies to a large and very distinct oriental species collected by Alfzelius in Guinea.

Seattle, Washington, *Frye;* Stanford University, California, *Dudley 147, Nohara 65, Miss Patterson 47; Abrams 147.*

7. RESUPINATUS (Nees) S. F. Gray, Nat. Arr. Brit. Pl. **1**: 617. 1821

Resupinatus atrocoeruleus (Fries)

Agaricus (Pleurotus) atrocoeruleus Fries, Syst. Myc. **1**: 190. 1821.

A cosmopolitan species easily recognized by its hairy surface and peculiar coloring.

California, *Harper 16.*

8. GEOPETALUM Pat. Hymén. Eur. 127. 1887

1. GEOPETALUM GEOGENIUM (DC.) Pat. Hymén. Eur. 127. 1887

For a description of this species, see MYCOLOGIA for January, 1912.

Seattle, Washington, *Murrill 288, 459, 584, Zeller.*

2. **Geopetalum porrigens** (Pers.)

Agaricus porrigens Pers. Obs. Myc. 1: 54. 1796.

Seattle, Washington, *Murrill 519, Zeller 56.*

3. **Geopetalum oregonense** sp. nov.

Pileus thin, sessile, conchate to flabelliform, convex to expanded, milk-white throughout, gregarious on dead wood, reaching 1 cm.; surface smooth, glabrous, margin entire, incurved when young and on drying; lamellae subdistant, inserted, rather narrow, white, slightly yellowish when dry; spores pip-shaped, smooth, hyaline, $6–7 \times 3–4\ \mu$; stipe wanting, the pileus attached to a small, subglobose, white, tomentose mass.

Type collected on fallen dead deciduous branches at Mill City, Oregon, November 9, 1911, *W. A. Murrill 821.* Also collected at Corvallis, Oregon, November 6–11, 1911, on dead deciduous branches, *W. A. Murrill 916, 998.* Related to *Pleurotus candidissimus* (Berk. & Curt.) Sacc.

4. **Geopetalum subsepticum** sp. nov.

Pileus fleshy, thin, flexible, white throughout, dimidiate and conchate to subcircular or reniform, attached to dead grasses, twigs, trunks, and leaves, solitary, scarcely reaching 1 cm. in breadth; surface smooth, glabrous, margin lobed, inflexed on drying; lamellae subdistant, plane, inserted, white, yellowish-brown on drying; spores narrowly oblong, smooth, hyaline, $7–9 \times 2–3\ \mu$.

Type collected on dead leaves, etc., in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 413.* Also collected near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 265, 533.* Related to *Pleurotus septicus,* but spore characters very different.

5. **Geopetalum densifolium** sp. nov.

Pileus fleshy, sessile, conchate to applanate, flabelliform, rather broadly attached, white throughout, gregarious, reaching 2 cm. broad; surface finely pubescent to subglabrous, smooth, margin entire, slightly inflexed on drying; lamellae very broad and very crowded, flaccid, overlapping on drying, white to isabelline, powdered with the spores, inserted, plane; spores ellipsoid, smooth, hyaline, $6–7 \times 3.5\ \mu$.

Type collected on dead deciduous wood in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 540.*

9. CREPIDOPUS (Nees) S. F. Gray, Nat. Arr. Brit. Pl. **1**: 616. 1821

1. CREPIDOPUS OSTREATUS (Jacq.) S. F. Gray, Nat. Arr. Brit. Pl. **1**: 616. 1821

Pleurotus ostreatus Quél. Champ. Jura Vosg. 77. 1872.

The white form of this species was found on decayed logs of alder, maple, and holly. I have never collected the dark European form in America.

Seattle, Washington, *Murrill 558;* Muir Woods, California, *Harper.*

2. **Crepidopus connatus** (Berk. & Curt.)

Agaricus (Pleurotus) connatus Berk. & Curt. Proc. Am. Acad. Arts & Sci. **4**: 115. 1858.

On an island in Bering Strait, Wright. Type not examined.

3. **Crepidopus serotinus** (Schrad.)

Pleurotus serotinus Quél. Ench. Fung. 149. 1886.

Pleurotus serotinoides Peck, Ann. Rep. N. Y. State Mus. **23**: 86. 1872.

Seattle, Washington, *Zeller 96;* British Columbia, *A. I. Hill 74.*

4. **Crepidopus subsapidus** sp. nov.

Pileus juicy, thin when dry, short-stipitate or attached by a narrow base, imbricate, spatulate to flabelliform, convex or plane, about 5 cm. broad; surface hygrophanous, smooth, glabrous, pallid to avellaneous; lamellae decurrent, somewhat furcate and anastomosing, inserted, rather close and narrow, thin, fragile, white, becoming pale-umbrinous on drying; spores narrowly oblong, pointed, smooth, lilac-tinted in mass, 8–9 × 3–3.5 μ; stipe, when present, short, lateral, white, strigose-tomentose at the base.

Type collected on an oak log in Muir Woods, California, November 22, 1911, *W. A. Murrill 1141.* Allied to the plant called *Pleurotus sapidus* in the eastern United States.

10. PLEUROTUS (Fries) Quél. Champ. Jura Vosg. 77. 1872

PLEUROTUS DRYINUS (Pers.) Quél. Champ. Jura Vosg. 77. 1872

This species is provided with a conspicuous veil and the surface is usually more or less areolate in appearance owing to the breaking up of the cuticle. *Pleurotus corticatus* (Fries) Quél. and *Pleurotus subareolatus* Peck are apparently not distinct. Found in Washington on decayed spots in living trunks of alder and large-leaved maple, sometimes reaching 13 cm. in breadth.

Seattle, Washington, *Murrill 386, 620.*

NEW COMBINATIONS

For the benefit of those accustomed to and desiring to use Saccardo's nomenclature, the following list of new combinations affecting some of the species described as new in this article and the previous one in MYCOLOGIA for March, 1912, is herewith appended.

CREPIDOPUS SUBSAPIDUS	= **Pleurotus subsapidus**
GEOPETALUM DENSIFOLIUM	= **Pleurotus densifolius**
GEOPETALUM OREGONENSE	= **Pleurotus oregonensis**
GEOPETALUM SUBSEPTICUM	= **Pleurotus subsepticus**
HYDROCYBE ARENICOLA	= **Hygrophorus arenicola**
HYDROCYBE CONSTANS	= **Hygrophorus constans**
HYDROCYBE CREMICOLOR	= **Hygrophorus cremicolor**
LIMACELLA MCMURPHYI	= **Lepiota McMurphyi**
LIMACELLA ROSEICREMEA	= **Lepiota roseicremea**
CERIOMYCES MIRABILIS	= **Boletus mirabilis**
CERIOMYCES OREGONENSIS	= **Boletus oregonensis**
CERIOMYCES ZELLERI	= **Boletus Zelleri**
CORIOLUS WASHINGTONENSIS	= **Polystictus washingtonensis**
SCUTIGER OREGONENSIS	= **Polyporus oregonensis**
SPONGIPELLIS SENSIBILIS	= **Polyporus sensibilis**
TYROMYCES CARBONARIUS	= **Polyporus carbonarius**
TYROMYCES CUTIFRACTUS	= **Polyporus cutifractus**
TYROMYCES PERDELICATUS	= **Polyporus perdelicatus**
TYROMYCES PSEUDOTSUGAE	= **Polyporus Pseudotsugae**
TYROMYCES SUBSTIPITATUS	= **Polyporus substipitatus**

NEW YORK BOTANICAL GARDEN.

ARTIFICIAL CULTURES OF ASCOBOLUS AND ALEURIA

B. O. Dodge

(With Plates 72 and 73, Containing 11 Figures)

Methods by which any considerable number of species of discomycetes can be successfully cultivated on artificial media have not as yet been worked out, and any additional information along this line may be of interest because of the value of such methods in connection with the study of the reproductive processes and the identification of species.

The writer has recently found a species of *Ascobolus* which seems to be quite different from any species described, both as to the characters recognized by the ordinary methods and those which can be brought out satisfactorily only by cultures from the germinated ascospores. The species has been under observation for about three months and has been grown on the natural substratum by transferring pieces of dung bearing young fruits, and has also been brought to maturity on agar media, the cultures having been started by germinating the ascospores by the methods already described (Bull. Torrey Club 39: 139–197). A more detailed account of the methods of reproduction, determined by a study of the fungus in the artificial cultures, will be given later, such reproductive features being noted at this time as can be observed without resorting to artificial cultures.

Ascobolus magnificus sp. nov.

Ascocarps scattered or closely crowded together, sessile, at first globose, closed, white or whitish, opening by a pore, the smooth white margin inrolled, becoming deeply cup-shaped, the lower portion of the exterior appearing pruinose from the projecting tips of thin-walled, hair-like hyphal branches which later become discolored and brownish, finally expanding, exposing the pale greenish-yellow surface of the hymenium, .5–2.7 cm. in diameter; asci cylindric-clavate, 200–300 $\times$ 18–25 μ, I +, 8-spored;

paraphyses linear, slightly enlarged above, septate, frequently with greenish, granular contents, 5–7 μ; spores ellipsoid, at first hyaline, then pale-lilac, finally rose-purple or violet, smooth, marked on one side by a line extending from end to end or obliquely across the surface, irregularly distichous at maturity, 20–25 $\times$ 12–14 μ, usually germinating at only one germ-pore; archicarp consisting of a stalk of 3–4 thick cells, a somewhat spherical ascogenous cell 35–45 μ in diameter, and a trichogyne with 7–10 cells, the outer cells coiling sharply inward at the tip, the complete archicarp coiled in one plane.

On horse dung in damp chamber cultures, New York City, April, 1912; type specimens deposited in the herbarium of the New York Botanical Garden.

The principal characters which distinguish this species are the large size of the plants, the beautiful white margin, the line extending across the surface of the spore, a single germ-tube, and the large archicarp in a flat coil. *Ascobolus applanatus* (Rabh. & Gonn.) Rehm, which Rehm (Disc. p. 1131) considers a doubtful species, is said to be 2 cm. in diameter; as to the other characters noted, it does not resemble this species. *A. major* B. & C., and *A. sarawacensis* Ces. are large species with smooth spores. *A. latus* Penz. & Sacc. and *A. laevisporus* Speg. are evidently more nearly related to *A. magnificus* but differ in the spore markings.

The line along the surface of the spore is visible before the spore becomes colored, and is not in the nature of a crack in the epispore, although a crack frequently develops along this line when the ejected spore is allowed to dry out; under such conditions numerous other cracks are formed in all directions, giving the spore a reticulated appearance.

The pruinosity of the exterior of the ascocarp would probably not be noticeable were the fungus grown in the open. Even in damp chambers, when specimens (Pl. 72, f. 4) become fully expanded and flattened out on the substratum (Pl. 73, lower figure), this pruinosity is no longer evident.

The very hard and brittle character of the thick flesh of the hypothecium is indicated by the way in which the ascocarps crack while expanding. (Plate 73, upper figure.)

The asci do not project prominently above the surface of the

hymenium, and after the whole surface has become deeply colored purple with ripe spores, on lifting the cover of the damp chamber the spores will be shot off in a cloud, just as is commonly the case with many of the large fleshy discomycetes.

The damp chamber cultures in which this fungus made its appearance had been kept about two weeks in a Wardian case, where they were exposed to the direct sunlight during part of the day. The substratum had been heavily watered while yet fresh so that at this time the mass was in a very putrid condition. The excessively high temperatures prevailing in this room and the condition of the substratum may perhaps account for the production of mature fruit bodies in which no colored spores were formed. In these cases all ejected spores were perfectly hyaline. Many of these spores had already germinated within the asci, and they also germinated readily in agar media without special treatment. When, however, the cultures were removed to a cooler room, colored spores were formed. As it was difficult to obtain uncontaminated cultures on agar by using the uncolored spores, several plates were inoculated with the colored spores and heated for thirty minutes in an oven, the final temperature of the oven being about 70° C. Spores in all the plates germinated. The ascocarps do not mature well on the agar media and it has been more satisfactory to transplant pieces of agar containing the mycelium or young fruit bodies to the dung where the supply of nutrient is less limited. Plate 73, upper figure, shows a culture obtained in this manner.

While fully 50 per cent. of the spores germinated in the earlier experiments, in the case of spores gathered about ten days later not over 1 per cent. could be made to grow by the heating process, and none germinated without heating.

Pure cultures of the species have not been obtained on account of the presence of a fungus which is parasitic on the mycelium of the *Ascobolus*. This parasite forms large numbers of fruit bodies, consisting when young of a central cell enclosed by protecting hyphae. It has been possible to trace a direct connection between the mycelium of the parasite bearing these fruit bodies and the mycelium of the host bearing its characteristic archicarp. As no spores of any description have been discovered,

further investigation will be necessary before the identity of the parasite can be determined. Portions of the mycelia of the host and of the parasite are shown in Plate 72, figs. 7 and 8.

ALEURIA UMBRINA Boud.

This fungus grows on burned places during the early part of the season in the vicinity of New York City. The species has been identified by Dr. F. J. Seaver. The outer surface is coarsely warted, especially in young specimens, where the stipe imbedded in the earth is also seen to be well developed. *Plicaria echinospora* (Karst.) Rehm, has been recorded as growing on burned places and the two species are apparently closely related.

Pure cultures of this species may be obtained easily by growing the spores on an agar medium made up with an extract of heated soil. When the spores are heated to 70°–80° C. for fifteen minutes, as described under "*Ascobolus carbonarius*" (Bull. Torrey Club 39: 139–197), germination is above 90 per cent. A large germ-tube is first formed and is usually followed later by a smaller one at the opposite end of the spore. (Pl. 72, f. 9.)

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EXPLANATION OF PLATE LXXII

Ascobolus magnificus Dodge

Fig. 1. (*a*) Ejected spores before drying. (*b*) After drying out the epispore is cracked in all directions. × 525. The width of the cracks is slightly exaggerated in the drawing.

Fig. 2. (*a*) Ungerminated spores. (*b*) Germinated spore. × 525.

Fig. 3. (*a*) Germinated spores. (*b*) A large spore much swollen. × 525.

Fig. 4. Section through an ascocarp showing hymenial layer and the tips of secondary mycelial hyphae (?) appearing as hairs on the exterior.

Fig. 5. Asci and paraphyses. (*a*) × 100; (*b*) × 300.

Fig. 6. Archicarp as it appears in youngest fruit bodies that can be seen with a hand lens. (*s*) The stalk; (*a*) ascogenous cell; (*t*) trichogyne. The size of the ascocarps at this time is indicated by the border line. × 150.

Figs. 7, 8. (*a*) Mycelium of a fungus parasitic on the mycelium. (*b*) Mycelium of the *Ascobolus*. × 525.

Aleuria umbrina Boud.

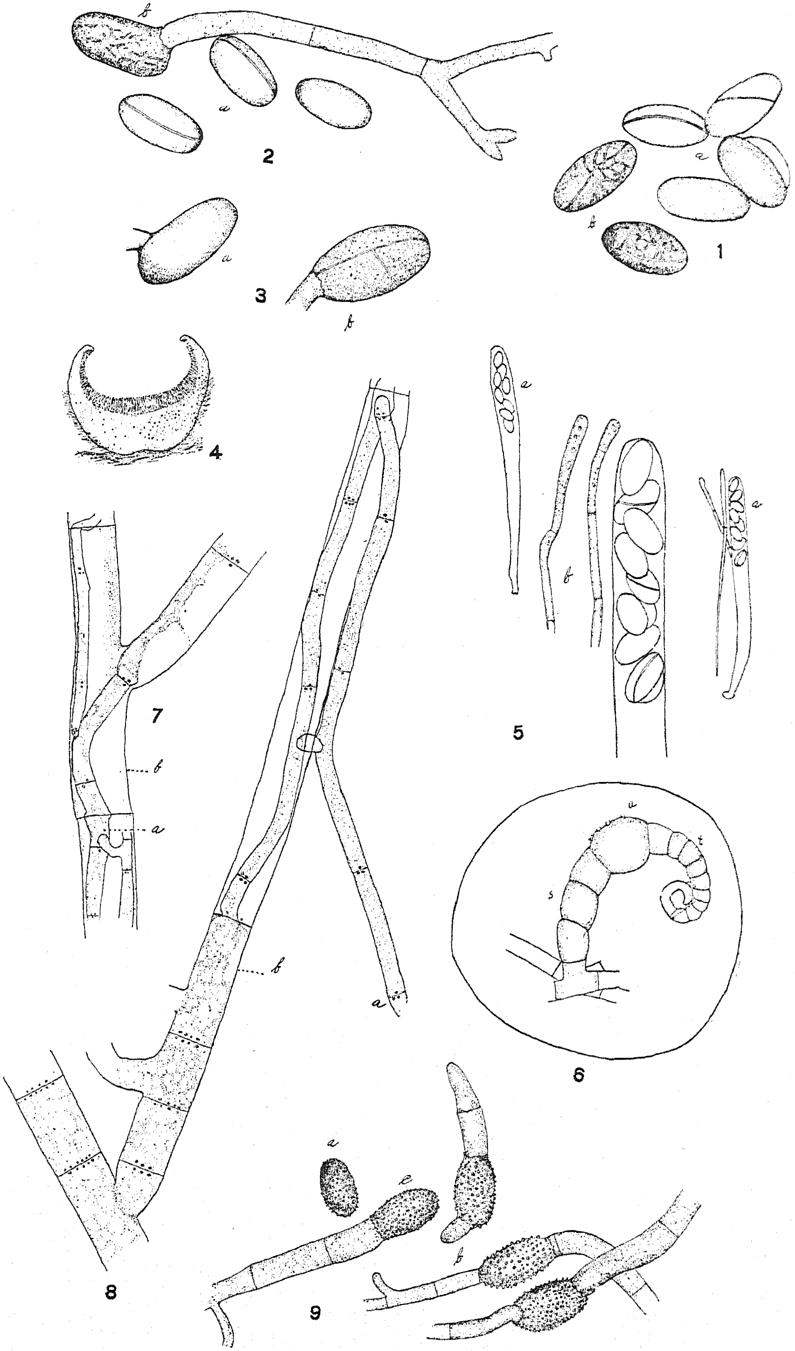
Fig. 9. (*a*) Ungerminated spore. (*b*) Germinated spores. (*c*) A spore with only one germ-tube. × 525.

EXPLANATION OF PLATE LXXIII

Ascobolus magnificus Dodge

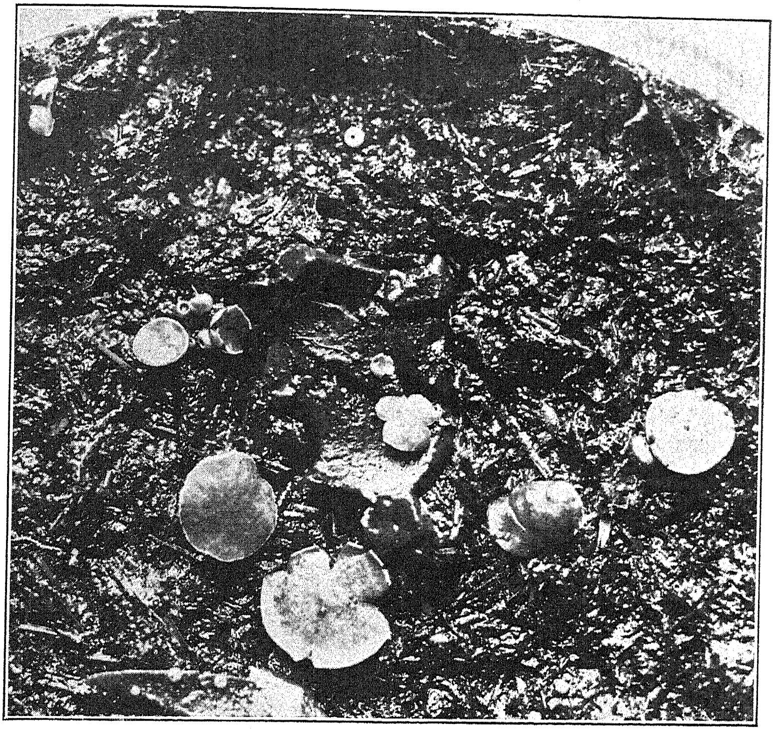
Two rather large ascocarps are shown natural size in the lower figure, the character of the white margin well brought out. At the extreme left may be seen two small fruit bodies. Seventeen ascocarps were later developed at this point, forming a compact mass of fruit bodies, each being about 1 cm. in diameter.

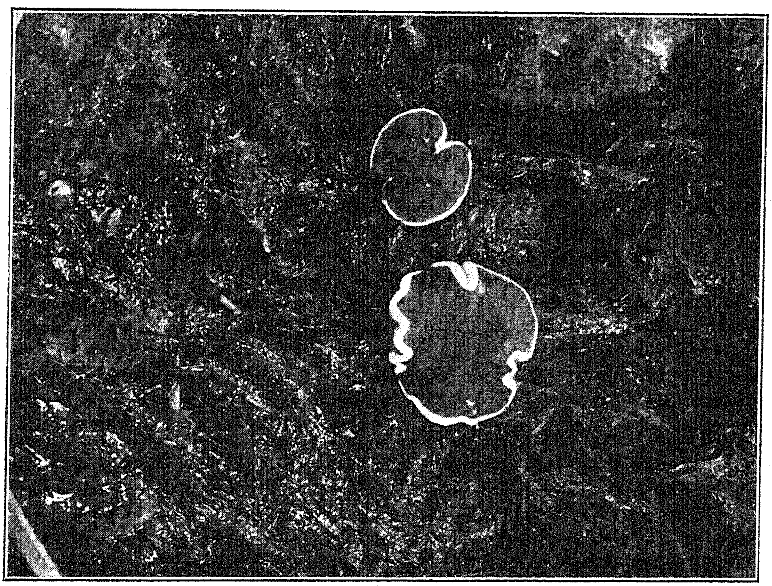
In the upper figure, are a number of young ascocarps showing the pore at the time of opening; the mature ascocarps are about the average size.



1–8. ASCOBOLUS MAGNIFICUS DODGE

9. ALEURIA UMBRINA BOUD.





ASCOBOLUS MAGNIFICUS DODGE

NEWS AND NOTES

The black canker of the chestnut tree, said to be due to the fungus, *Mycelophagus Castaneae,* which attacks the young roots and their mycorrhiza, has recently caused severe losses in France. The use of oak and Japanese chestnut stock has been suggested as a means of control.

Arnaud and Foëx have discovered the perithecia of the oak *Oidium* (Compt. Rend. 154: 124–127. 1912) and they refer the fungus to *Microsphaera quercina.*

An expert examination by C. Wehmer of structural timbers attacked by dry rot has revealed the presence in many instances of *Coniophora cerebella* and *Poria vaporaria* associated with *Merulius lacrymans.*

Part 3, volume 7, of NORTH AMERICAN FLORA, by J. C. Arthur and F. D. Kern, appeared April 15, 1912. Eighteen genera of plant rusts are treated in the 108 pages, the American species of *Gymnosporangium* alone numbering 32 and of *Nigredo* (*Uromyces*) 83.

Professor Bruce Fink, of Miami University, Oxford, Ohio, desires to see fresh material in abundance of species of the Collemaceae collected in various parts of New York State. This group of lichens is greatly in need of careful modern taxonomic treatment and Professor Fink will devote much of his time to it during the next two years.

The results of morphological and physiological researches on the genus *Coprinus,* by J. R. Weir, under the direction of Professors Goebel and Loew, were published in *Flora* in 1911. The paper comprises 60 pages of text and 25 figures.

An exhaustive report, containing 175 pages and 14 plates, on the history and cause of cocoanut bud-rot, by J. R. Johnston, appeared in February, 1912, as Bulletin 228 of the Bureau of Plant Industry at Washington. The author considers this serious disease as bacterial in origin and amenable to control by ordinary methods of sanitation and proper cultivation.

The seventh annual report of the Forest Park Reservation Commission of New Jersey, which has just been distributed, contains valuable suggestions regarding forest and shade trees and their protection, with some particularly good advice concerning the chestnut canker and its progress in the state.

A series of papers on the hymenomycetes of Lappland, by Lars Romell, was begun in *Arkiv för Botanik* **2**: 1911, the first paper on the Polyporaceae, in which 12 species are described as new, comprising 35 pages and two double plates. These studies are of special interest to mycologists in this country because of the close relationship that exists between the plants of Lappland and boreal America.

A preliminary report of 116 pages on the gill-fungi of Ohio, with keys to genera and species, by W. G. Stover, has just appeared as part 9, volume 5, of the *Proceedings of the Ohio State Academy of Science.* This report is not only a guide to the species recognized but also to the literature describing them, and should prove valuable to students and others interested in the Ohio gill-fungi. The term "preliminary" is used very advisedly, as no one realizes better than Mr. Stover how much there is still to learn about this subject.

Observations on *Marasmius oreades,* the "fairy-ring" mushroom, have been made by Jessie Bayliss (Jour. Econ. Biol. **6**: 111–132. *pl. 5–7.* 1911) with the following results, as reviewed in the *Experiment Station Record* for April, 1912.

It was found that *M. oreades* lives parasitically on grass. It attacks young roots, killing them by means of some toxic secretion. The fungus at first exerts a stimulating influence, and the grass

assumes a darker color owing to better nitrogenous nutrition. This is believed to be due to the proteolytic enzymes acting on the dead roots. There can always be distinguished a zone of dark-green grass outside as well as inside the zone of dead grass. The infected soil was found very impervious to moisture, owing probably to the air which is entangled within the meshes of the mycelium. It is thought that the fungus secretes a substance toxic to itself so as not to be able to grow in the same soil three years in succession. During the second year the fungus dies and the grass gains the ascendency and flourishes, owing to the increased nitrogenous material available. The secretion of this toxic substance is believed to account for the disappearance of rings between the places of intersection when fairy rings meet.

Dr. E. D. Clark has called attention in the June *Torreya* to a recent brief paper by Radais and Sartory which shows the impossibility of removing certain of the most deadly poisons from fleshy fungi by treating them with hot water. His translation of this paper is, as follows:

"The autumn of 1911 has brought the usual outbreak of mushroom poisoning, with many fatal cases, caused primarily by eating *Amanita phalloides* Fr. The press considered that it was doing a useful thing in spreading among the people, with the authority of naturalists whose intentions were more laudable than their knowledge, the incorrect and dangerous notion that in treating the mushrooms with boiling water followed by repeated washing in cold water, all danger in eating them had been removed. For a long time mycologists have recognized that this treatment will often remove certain very soluble bitter and poisonous principles but they have never ceased to put people on their guard against the inefficiency of this method in the case of certain species, especially *Amanita phalloides.* The present seems to be an opportune time to confirm this caution with experiments. Our observations were made upon several poisonous species but with special reference to *A. phalloides.* We may sum up the results of our experiments in the following words: *A. phalloides* still preserves its toxic principle unchanged after being heated to boiling for some time; in the dried state its

toxicity is not weakened after standing a year nor has it lost its poisonous properties after remaining dry for six years; the poison is still held in the tissues of the mushroom after boiling with water.

"Therefore it is very unwise to spread broadcast the erroneous idea that all poisonous mushrooms may be rendered harmless by boiling with water and then washing repeatedly in cold water."

INDEX TO AMERICAN MYCOLOGICAL LITERATURE

This index is prepared by Dr. B. O. Dodge, of Columbia University, and covers the same scope for the fungi as that covered by the general index published monthly in the Bulletin of the Torrey Botanical Club. It is not reprinted on cards for distribution.

Arthur, J. C. *Aecidiaceae* (continuatio). N. Am. Fl. **7**: 161–187, 211–268. 15 Ap 1912.

The part on *Gymnosporangium*, pp. 188–211, contributed by F. D. Kern.

Berger, E. W. Report of entomologist. Rep. Univ. Florida Agr. Exp. Sta. **1911**: xl–lvii. 1912.

Also contains notes on "Fungus diseases of whitefly."

Brooks, C., & Black, C. A. Apple fruit spot and quince blotch. Phytopathology **2**: 63–72. *pl. 4, 5.* Ap 1912.

Reprinted in Sci. Contrib. New Hampshire Agr. Exp. Sta. **5**: 63–72. *pl. 4, 5.*

Dodge, B. O. Methods of culture and the morphology of the archicarp in certain species of the *Ascobolaceae*. Bull. Torrey Club **39**: 139–197. *pl. 10–15. f. 1, 2.* 17 My 1912.

Dox, A. W. Enzyme studies of lower fungi. Plant World **15**: 40–43. F 1912.

Farlow, W. G. The fungus of the chestnut-tree blight. Science II. **35**: 717–722. 10 My 1912.

Brings together material relating to the identity of *Diaporthe parasitica* Murrill, suggesting possible relationship with *Endothia radicalis*.

Fawcett, H. S. Report of plant pathologist. Rep. Univ. Florida Agr. Exp. Sta. **1911**: lviii–lxvii. *f 7–9.* 1912.

Gives a short account of the occurrence of fungi causing rot and gumming of peach and orange trees.

Floyd, B. F. Report of plant physiologist. Rep. Univ. Florida Agr. Exp. Sta. **1911**: lxviii–lxxxi. *f. 10–14.* 1912.

Contains reports on experiments to determine the relation of fertilizers to diseases that affect the orange tree. He concludes that if melanose is a fungus it exists only in the vegetative condition.

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MYCOLOGIA

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THE AGARICACEAE OF THE PACIFIC COAST—II

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The present article deals with two series of gill-fungi, those with hyaline spores and those with ochraceous or ferruginous spores.

SERIES I. SPORES HYALINE

Species belonging to the genera ordinarily known as *Lepiota, Amanitopsis,* and *Amanita* are considered in this series. Some of these names, unfortunately, can no longer be used, but in the most important one, *Amanita,* the new name suggests the deadly nature of many of the species and should prevent any serious mistakes.

Annulus alone present.	1. LEPIOTA.
Volva alone present.	2. VAGINATA.
Volva and annulus both present.	3. VENENARIUS.

1. LEPIOTA (P. Browne) S. F. Gray, Nat. Arr. Brit. Pl. 1: 601. 1821

1. **Lepiota subnivosa** sp. nov.

Pileus thin, convex to plane, umbonate, solitary, 1.5–3 cm. broad; surface dry, smooth, somewhat striate at times, slightly innate-fibrillose, with a few scattered floccose scales, snow-white throughout or rose-tinted on the umbo; lamellae free, narrow, not crowded, white; spores ellipsoid, smooth, hyaline, uniguttulate, $7–8 \times 3.5\,\mu$; stipe thicker below, slender, glabrous, hollow, white, 5–9 cm. long and 2–4 mm. thick; annulus superior, white,

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fixed, rarely ample and persistent, usually breaking up and vanishing, especially in small plants.

Type collected on the ground in deep woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 336.* Also collected on banks in woods as follows: Seattle, Washington, *Murrill 304, 346, 485, 514, Zeller 105.* Related to *L. cristatella* Peck.

2. LEPIOTA CRETACEA (Bull.) Morgan, Jour. Myc. **13**: 3. 1907

Lepiota cepaestipes Quél. Champ. Jura Vosg. 35. 1872.

Seattle, Washington, *Murrill 537.*

3. **Lepiota petasiformis** sp. nov.

Pileus thin, hat-shaped, with prominent conic umbo, scattered or gregarious, 1.5–2.5 cm. broad; surface dry, rosy-isabelline, or about the color of the back of the hand, covered with an abundance of fine powder; lamellae free, subdistant, rather broad, white; spores ellipsoid, smooth, hyaline, minute, $3.5 \times 2\,\mu$; stipe slender, tapering upward, clothed with powder like the pileus, reaching 6 cm. long and 2–3 mm. thick; veil fugacious, not forming an annulus.

Type collected in humus in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 629.* Also collected in the same region, *Zeller 119.* It suggests some forms of *L. cretacea.*

4. LEPIOTA CRISTATA (Bolt.) Quél. Champ. Jura Vosg. 34. 1872

Seattle, Washington, *Murrill 356, 633, 695*; Stanford University, California, *McMurphy 30, 141;* Berkeley, California, *Harper;* Santa Cruz, California, *G. J. Streator.*

5. **Lepiota castaneidisca** sp. nov.

Pileus fleshy, regular, convex, umbonate, gregarious, 1.5–4 cm. broad; surface dry, white, with small, imbricate, avellaneous to light-chestnut scales, the umbo chestnut with unbroken cuticle; lamellae free, white, broad, ventricose, rather close; spores ellipsoid, smooth, hyaline, $5–6 \times 3\,\mu$; stipe cylindric, equal, hollow, glabrous, brownish-tinted, 4–7.5 cm. long, 3–10 mm. thick; annulus white, superior, delicate, inconspicuous.

Type collected on the ground under redwoods near Searsville Lake, California, December 11, 1911, *James McMurphy 123*. Related to *L. cristata*.

6. **Lepiota amplifolia** sp. nov.

Pileus convex to subexpanded, umbonate, gregarious, reaching 3.5 cm. broad; surface smooth, white, polished, with a few delicate, floccose, isabelline-testaceous scales, the umbo isabelline-testaceous with cuticle subentire; lamellae free, white, not crowded, very broad and triangular; spores oblong-ellipsoid, smooth, hyaline, $8–9 \times 3.5\,\mu$; stipe equal, finely fibrillose, hollow, white, becoming rose-tinted on drying, 7–9 cm. long, 2–4 mm. thick; veil white, evanescent, remaining only in small fragments clinging to the margin and stipe.

Type collected on the ground in a dense fir forest at Glen Brook, Oregon, November 7, 1911, *W. A. Murrill 738.* In a dried condition, this species somewhat resembles *L. mutata* Peck, described from Kansas in 1896.

7. **Lepiota Sequoiarum** sp. nov.

Pileus thin, convex to nearly plane, umbonate, gregarious, 2–4 cm. broad; surface dry, finely imbricate-fibrillose-scaly, white, the center more densely fibrillose and tinted with isabelline, the remainder of the surface being at times tinted with the same color in the scales; context loosely woven, thin, white; lamellae white, free, close, narrow; spores ovoid to ellipsoid, smooth, hyaline, $7–9 \times 3.5–4\,\mu$; stipe tapering upward, long, slender, white, smooth, glabrous, hollow, reaching 10 cm. long and 5 mm. thick; annulus superior, white, not fixed but collapsed on the stipe, persistent.

Type collected on the ground in Muir Woods, California, November 22, 1911, *W. A. Murrill 1143.*

8. **Lepiota fumosifolia** sp. nov.

Pileus convex, not umbonate, gregarious, 3 cm. broad; surface dry, white with isabelline, granular scales, the center isabelline; lamellae free, broad, rather crowded, white, becoming fumosous on drying; spores oblong-fusiform, smooth, hyaline, $12 \times 7\,\mu$; stipe equal or tapering upward, cylindric, smooth, white, furfuraceous, pale-avellaneous below, 6 cm. long, 6 mm. thick;

veil soon breaking into fragments which cling to the margin and stipe.

Type collected on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 229*.

9. **Lepiota castanescens** sp. nov.

Pileus small, thin, convex to subexpanded, prominently umbonate, 2–3 cm. broad; surface dry, densely appressed-fibrillose, white to rose-colored, glabrous and darker-red on the umbo, the entire surface changing to castaneous on drying; lamellae free, crowded, narrow, plane, white, becoming fumosous on drying; spores ellipsoid, smooth, pointed, strictly hyaline, $7–8 \times 3–4 \mu$; stipe tapering upward, slender, slightly fibrillose, hollow, about 6 cm. long and 2–5 mm. thick, white or rose-tinted, changing to castaneous on drying; annulus superior, fixed, ample, persistent, white, changing to castaneous on drying.

Type collected on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 397*.

10. **Lepiota roseilivida** sp. nov.

Pileus convex to expanded, thin, umbonate, gregarious, 2.5–4 cm. broad; surface dry, minutely and densely fibrillose-scaly, rose-lilac, livid in the center, becoming slightly darker on drying; lamellae white, unchanging, free, crowded, narrow; spores ellipsoid, smooth, hyaline, $8–9 \times 4–5 \mu$; stipe slender, tapering upward, subglabrous, white or pallid, changing to lilac on drying, hollow, 7–10 cm. long, 2–5 mm. thick; annulus superior, movable, ample, membranous, lilac-tinted, becoming lilac on drying.

The type of this beautiful species was collected on the ground in Muir Woods, California, November 22, 1911, *W. A. Murrill 1138*.

11. **Lepiota subfelina** sp. nov.

Pileus thin, convex to expanded, distinctly umbonate, solitary, about 2 cm. broad; surface dry, white, densely covered with small, latericious, imbricate scales, the umbo bay, with strigose-tomentose covering; lamellae free, rather broad, plane, close, white; spores oblong-ellipsoid, smooth, hyaline, $8 \times 4 \mu$; stipe very slender, slightly tapering upward, white and finely fibrillose above, avellaneous with a rosy tint below, and decorated with latericious fragments resembling the scales on the pileus, 4 cm. long, 2–2.5 mm. thick; veil obsolete, not forming an annulus.

Type collected on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 349*. Also collected at the same time in the same region, *W. A. Murrill 622*. In the latter collection, one pileus has the cuticle ruptured concentrically and the scales drawn together into rather coarse gemmate warts or ridges.

12. **Lepiota concentrica** sp. nov.

Pileus rather thick, convex to subexpanded, scarcely umbonate, solitary, 3–4 cm. broad; surface dry, white with yellowish tints between concentric rows of coarse, strigose-floccose, latericious, raised scales formed from the deeply ruptured cuticle, the unruptured central portion being fuliginous; margin uneven, eroded, bearing fragments of the fugacious white veil; lamellae white, free, rather broad and close; spores ovoid, smooth, hyaline, $6 \times 3.5\,\mu$; stipe tapering upward, decorated with fibrils from the veil, hollow, white above, cremeous and more shaggy below, 7–9 cm. long, 5–15 mm. thick.

Type collected on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 587*. Also collected in the same region, *Zeller 103*. Related to *Lepiota fuscosquamea* Peck.

13. **Lepiota roseifolia** sp nov.

Pileus regular, convex to subexpanded, solitary, 4 cm. broad; surface dry, shining, innate-fibrillose, radiate-rimose, smooth and glabrous at the center, castaneous, blackish-tinted when fresh, assuming a more reddish tint after picking; lamellae free, crowded, slightly ventricose, regular, white when fresh, changing to rose-colored on drying or when bruised; spores ellipsoid, smooth, hyaline, $7\text{–}8 \times 3\text{–}3.5\,\mu$; stipe equal, compressed, very long because buried in leaves, hollow, smooth, glabrous, avellaneous-isabelline, white at the apex, 17 cm. long, 5 mm. thick; annulus superior, slight, fixed, fuliginous.

Type collected in humus in a redwood forest at La Honda, California, November 25, 1911, *W. A. Murrill & L. R. Abrams 1287*.

14. LEPIOTA BRUNNESCENS Peck, Bull. Torrey Club 31: 177. 1904

Stanford University, California, *Baker 149;* Searsville Lake, California, *McMurphy 45*. Described from plants collected near St. Louis by Glatfelter. The western plants are not entirely typical, but they show the same decided change in color.

15. LEPIOTA NAUCINA (Fries) Quél. Champ. Jura Vosg. 35. 1872

Stanford University, California, *Dudley 73, 324, Baker 133* (in part); Pasadena, California, *McClatchie.*

16. **Lepiota fuliginescens** sp. nov.

Pileus convex to subexpanded, solitary, about 8 cm. broad; surface dry, finely imbricate-floccose-scaly, slightly rimose, white with rosy tints, becoming fuliginous on drying; lamellae free, distant, narrow, arcuate, white, changing to pale-latericeous on drying; spores regularly ovoid, smooth, hyaline, $6 \times 4\,\mu$; stipe long and twisted owing to its struggle through the leaves, tapering upward, polished, hollow, colored and changing like the pileus, about 10×1 cm.; annulus superior, ample, fixed, white to pale-fuliginous.

Type collected on the ground in a redwood forest at La Honda, California, November 25, 1911, *W. A. Murrill & L. R. Abrams 1265.*

17. **Lepiota rubrotinctoides** sp. nov.

Pileus convex to nearly plane, often umbonate, sometimes depressed in old plants, solitary or gregarious, 4–7 cm. broad; surface dry, subglabrous, white with rosy tints to red or purplish, the center always darker, varying from pink or red to dark-purple or blackish, cuticle even and unbroken when young, splitting radially, especially on the margin, as the pileus expands; context thin, white, drying soft and flexible; lamellae free, narrow, close, plane, white, the edges minutely serrulate; spores subovoid, smooth, hyaline, with a large clear nucleus, $7 \times 3.5\,\mu$; stipe long and slender, equal or slightly tapering upward, hollow, glabrous or somewhat fibrillose, white, $10\text{–}15 \times 0.5\text{–}1$ cm.; annulus superior, fixed, membranous, ample, white, persistent.

Type collected on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 286.* Very abundant in the forests on the Pacific coast, and very constant in form, although varying in the amount of red coloring matter in the cuticle. It differs from *L. rubrotincta* Peck in its larger size, darker umbo, smaller spores, and the absence of scales on the surface of the pileus. Other collections are as follows: Seattle, Washington, *Murrill 338, 422, 573, Zeller 90;* Glen Brook, Oregon, *Murrill 768;* Muir Woods, California, *Murrill 1142;* La Honda, California, *Murrill & Abrams 1304;* Searsville Lake, California, *McMurphy 95, 96.*

18. **Lepiota magnispora** sp. nov.

Pileus thin, conic to convex, with a more or less prominent umbo, finally nearly plane, 3–5 cm. broad; surface dry, shaggy, imbricate-floccose-scaly, the umbo fulvous with erect scales, the rest of the surface pale-isabelline with numerous, darker isabelline or fulvous, upturned scales thinning out toward the margin, which is decorated with projecting scales and fragments of the veil; lamellae free, not crowded, of medium width, white; spores oblong-fusiform, smooth, hyaline, $15–18 \times 4–5 \mu$; stipe slightly tapering upward, with a small bulb at the base, glabrous at the apex, very floccose-tomentose and isabelline below, about 9 cm. long and 6 mm. thick; veil cottony, ample, ochraceous-isabelline, not forming an annulus but adhering to the margin and stipe.

Type collected on the ground among dead leaves in deep woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 704.* Also collected as follows: Seattle, Washington, *Murrill 512, 518, 601, Zeller 114;* Stanford University, California, *Miss Patterson 23.*

19. LEPIOTA AMIANTHINA (Scop.) Quél. Ench. Fung. 7. 1886

This is a variable and widely distributed temperate species which has received many names, among them *Lepiota granulosa, L. carcharias, L. rugoso-reticulata, L. adnatifolia,* and *L. granosa.* Forms with coarse granules and rather brilliant colors are commonly referred to *L. granulosa,* while those with fine

granules and paler coloring are called *L. amianthina* or *L. granulosa amianthina.* There is little doubt that Scopoli in 1772 knew both these forms. Another character in which this species is both aberrant and variable is the attachment of the gills, which are sometimes squarely adnate or even a little decurrent and at other times they are adnexed or barely reach the stipe. All these variations in granular covering and gill attachment are represented on the Pacific coast, where the plant is common. When the species is more thoroughly known in its entire range, it may be possible to recognize two or three of these forms as species, and it may also be more consistent to group them under a distinct genus between *Lepiota* and *Armillaria,* as suggested by Fayod in 1889.

Seattle, Washington, *Murrill 320, 457, 472, 571, 588, 645, 678;* Tacoma Prairies, Washington, *Murrill 715;* Glen Brook, Oregon, *Murrill 743;* Corvallis, Oregon, *Murrill 910, 954, 957;* Newport, Oregon, *Murrill 1077;* Salem, Oregon, *M. E. Peck.*

20. LEPIOTA ASPERA (Pers.) Quél. Ench. Fung. 5. 1886

This rather rare but widely distributed temperate species was found only once. *L. asperula* Atk. and *L. eriophora* Peck, described from American material, should be compared with it carefully.

Seattle, Washington, *Murrill 436.*

21. **Lepiota nardosmioides** sp. nov.

Pileus thick, fleshy, convex, slow to expand, 6 cm. broad in its unexpanded form, resembling that of *Armillaria nardosmia* in form and color; surface dry, fibrillose, castaneous, becoming somewhat mottled with lighter and darker areas, margin strongly incurved; lamellae free, crowded, broad, ventricose, pallid; spores ovoid to ellipsoid, smooth, hyaline with an umbrinous tint, $5–7 \times 3.5–4\,\mu$; stipe short, 2.5 cm. thick, bulbous, white, glabrous above and cottony below the large, membranous, simple, white, persistent annulus, which is fixed above the center of the stipe and is decidedly cottony on its lower surface.

Type collected on humus in a redwood forest at La Honda, California, November 25, 1911, *W. A. Murrill & L. R. Abrams 1250.*

2. VAGINATA (Nees) S. F. Gray, Nat. Arr. Brit. Pl. 1: 601. 1821

Amanitopsis Roze, Bull. Soc. Bot. Fr. 23: 50. 1876.

1. VAGINATA VAGINATA (Bull.) Murrill, Mycologia 3: 80. 1911

Found in its grisette form only and rather sparingly, but sometimes reaching 12 cm. in diameter, with a huge, subglobose, inflated volva resembling that of *A. volvata*.

Glen Brook, Oregon, *Murrill 749;* Mill City, Oregon, *Murrill 831;* Corvallis, Oregon, *Murrill 925;* Newport, Oregon, *Murrill 1080;* La Honda, California, *Murrill & Abrams 1268;* Santa Cruz, California, *G. J. Streator.*

2. **Vaginata velosa** (Peck)

Amanitopsis velosa Peck, Bull. Torrey Club 22: 485. 1895.

This species, described from material sent from Pasadena by McClatchie, is near *V. vaginata,* but has large whitish volval patches on the buff-colored pileus. It is abundant in southern California, almost to the exclusion of the common eastern species.

Pasadena, California, *McClatchie;* Stanford University, California, *Nohara 56, Miss Patterson 62, Baker 154, 381;* Searsville Lake, California, *W. F. Wight 159.*

3. VENENARIUS Earle, Bull. N. Y. Bot. Gard. 5: 450. 1909

The type of *Amanita* is *Agaricus campestris, Amanita* thus being a synonym of *Agaricus.* Earle erected the new genus *Venenarius for A. muscaria* and other species in which the basal volva breaks into fragments, leaving *Leucomyces* of Battarra for the remaining species. More recent usage discards Battarra's genus as not based on binomial publication, leaving the one genus *Venenarius,* which, in my opinion, is quite sufficient for all the species of *Amanita* as ordinarily considered.

1. VENENARIUS MUSCARIUS (Fries) Earle, Bull. N. Y. Bot. Gard. 5: 450. 1909

Brilliant orange and red sporophores of this deadly species were found in abundance in the sandy pine barrens at Newport, Oregon, and fresh specimens were shown me by Professor Setchell at Berkeley, California.

Newport, Oregon, *Murrill 1032;* Monterey, California, *Dudley 323.*

2. **Venenarius solitarius** (Bull.)

Agaricus solitarius Bull. Herb. Fr. *pl. 48.* 1780.

Stanford University, California, *Dudley 145, McMurphy 6.*

3. **Venenarius phalloides** (Vaill.)

Agaricus phalloides Fries, Syst. Myc. 1: 13. 1821.

No fresh plants of this deadly poisonous species were seen during my stay on the Coast, but Professor Campbell told me of a white species that occurs about Stanford University having the characters of *V. phalloides,* and the specimens cited below, which are without notes, may represent it. The spores of these specimens are subglobose to ovoid, smooth, hyaline, 8–10 × 6–7 μ.

Santa Cruz Mountains, California, *Dudley 99;* Santa Cruz, California, *G. J. Streator.*

4. **Venenarius ocreatus** (Peck)

Amanita ocreata Peck, Bull. Torrey Club 36: 330. 1909.

Pileus fleshy, convex or nearly plane, glabrous, even on the margin, white, flesh white; lamellae close, unequal, broadly sinuate, white; stem equal, solid, glabrous or slightly fibrillose below the annulus, minutely floccose above, white, the annulus thin, membranaceous, the volva white, soft, deep with an entire free margin; spores subglobose or elliptic, 10–12 × 8–10 μ.

Pileus 4–6 cm. broad; stem 8–10 cm. long, 1–2 cm. thick.

Described from specimens collected by Baker under oaks at Claremont, California. Types not seen. Evidently closely related to the white forms of *V. phalloides.*

5. **Venenarius bivolvatus** (Peck)

Amanita bivolvata Peck, Bull. Torrey Club 36: 329. 1909.

Pileus fleshy, convex or nearly plane, at first viscid, striate on the margin, white, brownish in the center, flesh white; lamellae close, unequal, free, white; stem equal, solid, flocculose, annulate, white, the annulus narrow, often disappearing with age, the volva large, thick, soft, spongy, lobed on the outer margin and having an elevated entire inner margin surrounding the stem; spores subglobose or broadly elliptic, 10–12 × 8–10 μ.

Pileus 7–10 cm. broad; stem 13–15 cm. long, 1.6–2.5 cm. thick.

Described from specimens collected by Baker under oaks at Claremont, California. Types not seen.

6. **Venenarius calyptratus** (Peck)

Amanita calyptrata Peck, Bull. Torrey Club 27: 14. 1900.

Pileus fleshy, thick, convex or nearly plane, centrally covered by a large irregular persistent grayish-white fragment of the volva, glabrous elsewhere, striate on the margin, greenish-yellow or yellowish-brown tinged with green, the margin often a little paler or more yellow than the rest: lamellae close, nearly free but reaching the stem and forming slight decurrent lines or striations on it, yellowish-white tinged with green: stem stout, rather long, equal or slightly tapering upward, surrounded at the base by the remains of the ruptured volva, white or yellowish white with a faint greenish tint: spores broadly elliptic, 10 μ long, 6 μ broad, usually containing a single large nucleus.

Pileus 10–20 cm. broad: stem 10–15 cm. long, 12–20 mm. thick.

Described from specimens collected by Dr. H. Lane in fir forests in Oregon. The volva wall is one-fourth to one-half inch thick in the "egg" stage, and the pileus is apparently unable to break through it at times, thus dying and decaying in its infancy. Dr. Lane thoroughly tested the edibility of this species and found it good and wholesome.

7. **Venenarius calyptratoides** (Peck)

Amanita calyptratoides Peck, Bull. Torrey Club 36: 329. June, 1909.

Amanita calyptroderma Atkinson & Ballen, Ann. Myc. 7: 365. August, 1909.

Pileus fleshy, convex, then nearly plane, striate on the margin, covered in the center by a large irregular adhering fragment of the white universal veil or by small fragments formed by the breaking up of the veil, grayish-brown or lead-colored or sometimes ochraceous or cream-colored, flesh white, taste mild; lamellae moderately close, unequal, sinuate, adnexed, white; stem nearly equal, hollow, striate at the top, white, the slight evanescent annulus soon disappearing or becoming inconspicuous; spores often uninucleate, broadly elliptic, $10–12 \times 6–8\,\mu$, usually with an oblique apiculus at one end.

Pileus 4–8 cm. broad; stem 8–12 cm. long, 8–16 mm. thick.

Described from specimens collected by Baker at Claremont, California. Mrs. Ballen's specimens, judging from her description, agree substantially, only they are somewhat larger. *V. calyptrata* is distinguished chiefly by its greenish tints.

8. **Venenarius umbrinidiscus** sp. nov.

Pileus fleshy, drying very thin, convex to expanded, at length depressed, umbonate, solitary, reaching 10 cm. broad; surface moist, glabrous, with large, irregular, adherent patches of the white volva, melleous, fading to stramineous on the conspicuously long-striate margin, the umbo yellow in young plants, becoming umbrinous; lamellae free, broad, not crowded, white; spores large, subglobose, smooth, hyaline, $7–9\,\mu$; stipe white or slightly yellowish, tapering upward, 12 cm. long, 1–2 cm. thick; annulus ample, white, persistent, fixed above the center of the stipe; volva rather short, white, tough, 3 cm. broad, with subentire free limb.

Type collected on the ground in a fir forest near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 414*. Also collected in the same region, *S. M. Zeller 100*. The flesh and gills are freely eaten by slugs. Related to *Amanita virosa*.

9. **Venenarius pantherinoides** sp. nov.

Pileus thick, fleshy, globose to plane, solitary, reaching 10 cm. broad; surface melleous or dirty-cremeous with brown or chestnut center, sticky when wet, slightly striate in old plants, the white volval patches small, numerous, regular, and regularly distributed until many of them fall away with age; lamellae sinuate, crowded, plane, white; spores ovoid, smooth, hyaline, $9 \times 5\,\mu$; stipe tapering upward, white, glabrous, reaching 11 cm.

long and about 2 cm. thick, with bulbous base; annulus large, white, superior, persistent; volva white, 3 cm. broad, tough, regular, persistent, with entire or undulate free limb.

Type collected on a south slope in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 399*. Also collected as follows: Seattle, Washington, *S. M. Zeller 80, W. A. Murrill 328;* Newport, Oregon, in sandy pine barrens, *W. A. Murrill 1092*. Specimens at Albany sent by Copeland from California and temporarily referred by Peck to *Amanitopsis adnata* appear to belong here, but I have not examined them microscopically.

10. **Venenarius praegemmatus** sp. nov.

Pileus hemispheric to subexpanded, often splitting at the margin with age, scattered, reaching 6 cm. broad; surface smooth, melleous-avellaneous in the center, dark-melleous on the margin, not striate, densely covered with persistent, white, cottony, gemmate warts, the remains of the volva; lamellae free, crowded ventricose, white; spores ovoid to subglobose, smooth, hyaline, 8–10 μ; stipe tapering upward from a bulbous base, smooth, white, reaching 7 cm. long and 1.5 cm. thick; annulus ample, white, persistent, fixed just above the middle of the stipe; volva white, 3 cm. broad, 2 cm. high, closely attached to the bulb and scarcely showing a free limb, without friable remains in the soil.

Type collected on sandy soil in open woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 247*. Also collected as follows: Seattle, Washington, *W. A. Murrill 548, 646;* Coos Bay, Oregon, *H. D. House 76*. Fresh specimens suggest one of the honey-colored forms of *V. muscaria*, and dried specimens are not very different from small plants of *A. rubescens*.

SERIES 2. SPORES OCHRACEOUS OR FERRUGINOUS

Several departures from ordinary generic usage are made here. In using the key, please bear in mind that *Cortinarius, Inocybe, Hebeloma,* and *Naucoria* are not considered, these genera being reserved for later publication.

Lamellae readily separable from the context.
- Stipe lateral or none. — 1. TAPINIA.
- Stipe central or eccentric. — 2. PAXILLUS.

Lamellae not readily separable from the context.	
Volva and annulus absent; veil evanescent, if present.	
Pileus dimidiate or resupinate.	3. CREPIDOTUS.
Pileus centrally stipitate.	
Stipe cartilaginous.	
Lamellae free.	4. PLUTEOLUS.
Lamellae adnate or adnexed; margin of pileus straight from the first.	5. CONOCYBE.
Lamellae decurrent.	6. TUBARIA.
Stipe fleshy; lamellae adnate or decurrent; universal veil not arachnoid.	7. GYMNOPILUS.
Volva absent, annulus present.	
Stipe glabrous or fibrillose.	8. PHOLIOTA.
Stipe squarrose-scaly.	9. HYPODENDRUM.
Volva present, annulus absent.	10. LOCELLINA.

1. TAPINIA (Fries) Karst. Hattsv. 452. 1879

TAPINIA PANUOIDES (Fries) Karst. Hattsv. 452. 1879

Seattle, Washington, *Murrill 313, 515, 530, Zeller 40;* Berkeley, California, *Harper.*

2. PAXILLUS Fries, Gen. Hymen. 8. 1836

1. PAXILLUS INVOLUTUS (Batsch) Fries, Gen. Hymen. 8. 1836

Corvallis, Oregon, *Murrill 1013;* Stanford University, California, *McMurphy 137.* Found in abundance under conifers on the campus of the Agricultural College, the pileus sometimes reaching over a foot in breadth.

2. PAXILLUS ATROTOMENTOSUS (Batsch) Fries, Epicr. Myc. 317. 1838

Coos Bay, Oregon, *H. D. House 86.*

3. CREPIDOTUS (Fries) Quél. Champ. Jura Vosg. 106. 1872

1. CREPIDOTUS HERBARUM Peck, Ann. Rep. N. Y. State Mus. **39**: 72. 1886

Agaricus (Crepidotus) Herbarum Peck, Ann. Rep. N. Y. State Mus. **26**: 56. 1874.

Seattle, Washington, *Murrill 660;* Tacoma, Washington, *Murrill 719;* Stanford University, California, *Dudley 156, 175, McMurphy 146.*

2. CREPIDOTUS MALACHIAS (Berk. & Curt.) Peck, Ann. Rep. N. Y. State Mus. **39**: 71. 1886

Seattle, Washington, *Murrill 314*.

3. CREPIDOTUS MOLLIS (Schaeff.) Quél. Champ. Jura Vosg. 106. 1872

Seattle, Washington, *Zeller 126;* La Honda, California, *Murrill & Abrams 1273;* California, *McClatchie*.

4. **Crepidotus submollis** sp. nov.

Pileus sessile, reniform to subcircular, lobed, wood-loving, 2–4 cm. broad; surface white to discolored, finely silky, radially sulcate or plicate, strigose-hirsute behind; lamellae white to ferruginous, rather broad, not distant, edges concolorous; spores ellipsoid, smooth, melleous under a microscope, 9×4–$5\,\mu$.

Collected on dead alder in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 572* (*type*), *603*. Also collected at Berkeley, California, February 7, 1911, *R. A. Harper 27*.

5. CREPIDOTUS PUBERULUS Peck, Bull. Torrey Club **25**: 324. 1898

Pileus thin, reniform or suborbicular, nearly plane, wood-loving, 6–10 mm. broad; surface minutely pubescent, brown; lamellae ventricose, rather broad, rusty-brown when mature, whitish on the edge; spores subellipsoid, usually uninucleate, 9–10×5–$6\,\mu$; stipe 2–4 mm. long, equal, curved, lateral or eccentric, brown, with a patch of white mycelium at the base.

Compton, California, *McClatchie*.

6. CREPIDOTUS CALOLEPIS (Fries) Quél. Ench. Fung. 108. 1886

Crepidotus fulvotomentosus Peck, Ann. Rep. N. Y. State Mus. **26**: 57. 1874.

Corvallis, Oregon, *Murrill 907*.

4. PLUTEOLUS (Fries) Gill. Champ. Fr. **1**: 549. 1878

1. PLUTEOLUS LUTEUS Peck, Bull. Torrey Club **22**: 203. 1895

Described from specimens collected by McClatchie under trees near Pasadena, California, in December. Specimens from Stanford University, California, *Baker 161,* distributed as *Bolbitius radians* Morg., are much larger than the types, reaching 7 cm. broad and 10 cm. high.

Pasadena, California, *McClatchie;* Stanford University, California, *Baker 161, 380, Miss Patterson 13, 67, Nohara 28;* California, *Harper 14.*

2. **Pluteolus stramineus** sp. nov.

Pileus thin, convex, solitary, 5 cm. broad; surface glabrous, viscid, flavous and rugose at the center, pale-stramineous and closely and conspicuously striate from the central area to the margin; lamellae narrow, free or slightly adnexed, twice inserted, dull dirty-stramineous; spores ovoid, smooth, bright ochraceous-melleous under a microscope, $11–14 \times 6–8\,\mu$; stipe perfectly straight, cylindric, equal, fleshy, smooth, stramineous, pulverulent above, hollow, 10 cm. long, 5 mm. thick.

Type collected in an open grassy yard after a light rain, Corvallis, Oregon, November 6–11, 1911, *W. A. Murrill 1019.* Related to *Pluteolus luteus.*

3. PLUTEOLUS CALIFORNICUS McClatchie, Proc. S. Cal. Acad. Sci. **1**: 383. 1897

Described from plants collected by McClatchie on dead stems and manure at Compton, California. The specimens sent to Dr. Peck appear to be quite distinct from *P. luteus.*

4. **Pluteolus parvulus** sp. nov.

Pileus convex to subplane, thin, solitary, scarcely 1 cm. broad; surface smooth, glabrous, shining, slightly viscid, dark-avellaneous, the small umbo concolorous, margin striate; lamellae free, ventricose, broad, fulvous, the edges white and minutely serrulate; spores ellipsoid, regular, smooth, bright-melleous under a microscope, $9–11 \times 5\,\mu$; stipe enlarged at the apex, pulverulent above, glabrous below, smooth, straw-colored, hollow, flaccid and collapsing, 2 cm. long, 1 mm. thick.

The type of this dainty little species was collected in humus on the ground in woods at Preston's Ravine, near Palo Alto, California, November 25, 1911, *W. A. Murrill & L. R. Abrams 1189.* Related to *P. callistus,* but smaller and lacking the red center.

5. CONOCYBE Fayod, Ann. Sci. Nat. VII. **9**: 357. 1899

Galera (Fries) Quél. Champ. Jura Vosg. 103. 1872. Not *Galera* Blume 1825.

1. CONOCYBE TENER (Schaeff.) Fayod, Ann. Sci. Nat. VII. **9**: 357. 1899

This species is rather common, the usual form being slender and small. No. 395, however, growing in a compost heap at the edge of a woodland, is large, with isabelline cap and fulvous stipe, resembling the form sometimes called *G. sphaerobasis* Post. Specimens of *C. tener* from California have been referred by some to *Galera versicolor* Peck, but this species, described in 1897 from South Dakota material collected by Williams, is not a *Galera* but a *Pluteolus,* near *P. luteus* and *P. expansus.*

Seattle, Washington, *Murrill 395, 609;* Corvallis, Oregon, *Murrill 1004;* Preston's Ravine, California, *Murrill & Abrams 1167, 1180;* Stanford University, California, *Dudley 77, Baker 127, 1868;* California, *Miss Sutliff.*

2. CONOCYBE HYPNORUM (Batsch) Murrill, Mycologia **4**: 75. 1912

Seattle, Washington, *Murrill 421, 446;* Preston's Ravine, California, *Murrill & Abrams 1217.* Stanford University, California, *L. R. Abrams 202a.*

3. **Conocybe Bryorum** (Pers.)

Galera Bryorum (Pers.) Sacc. Syll. Fung. **5**: 868. 1887.

Seattle, Washington, in peat bog, *Murrill 391;* Tacoma Prairies, Washington, *Murrill 716.*

4. **Conocybe Sphagnorum** (Pers.)

Galera Sphagnorum (Pers.) Sacc. Syll. Fung. **5**: 869. 1887.

Kadiak, Alaska, *Trelease 511;* Yakutat, Alaska, *Trelease 514a, 516.* This species has a much longer stipe than *C. Bryorum,* but the two are closely related. I have not seen the Alaskan specimens here listed.

5. **Conocybe semilanceata** (Peck)

Galera semilanceata Peck, Bull. Torrey Club **23**: 415. 1896.

Pileus membranous, acutely conic or campanulate, often sharply umbonate, glabrous, sulcate-striate, pale-yellow or buff; lamellae rather broad, ascending, distant, adnate, tawny-ferruginous when mature; stem slender, glabrous, hollow, pallid; spores ellipsoid, ferruginous, $10–12.5 \times 5–6\,\mu$; pileus 4 to 6 lines broad; stem 1.5 to 2 in. long, .5 to 1 line thick.

Described from specimens collected by Yeomans among fallen leaves, sticks, mosses, etc., at Camas, Washington. The types at Albany are somewhat broken and rather difficult to compare.

6. **Conocybe angusticeps** (Peck)

Galera angusticeps Peck, Bull. Torrey Club **24**: 143. 1897.

Pileus thin, narrowly and irregularly conic or subcylindric, obtuse, acute, or abruptly acuminate at the apex, even, glabrous, viscid and dark-ochraceous when young and moist, nearly white when old and dry, the margin somewhat incurved and appressed to the stem; lamellae close, narrow, adnate, somewhat white-margined, more or less anastomosing, brownish-ferruginous when mature; stem slender, glabrous, hollow, equal or slightly thickened at the base, whitish or tinged with yellow, shining when dry; spores ellipsoid, $10–12.5 \times 7.5\,\mu$. Pileus 8–15 lines long, 4–6 lines wide; stem 1.5–3 in. long, 1–1.5 lines thick.

Described from specimens collected by McClatchie on grassy ground in streets and pastures, at Pasadena, Los Angeles, and Compton, California. The pileus is viscid, estriate, and does not expand. *G. Besseyi,* described from Colorado, is apparently not distinct.

7. **Conocybe lirata** (Berk. & Curt.)

A. (*Galera*) *liratus* Berk. & Curt. Proc. Am. Acad. Arts & Sci. **4**: 116. 1858.

Galera lirata (Berk. & Curt.) Sacc. Syll. Fung. **5**: 865. 1887.

Described from specimens collected by Wright on the bark of oak trees on Mare Island, California. Pileus very small, umbilicate, reddish, atomaceous, margin striate; gills adnate, few, broad; stipe short. Types not seen.

6. TUBARIA (W. G. Sm.) Gill. Champ. Fr. **1**: 537. 1878

1. TUBARIA FURFURACEA (Pers.) Gill. Champ. Fr. **1**: 538. 1878

This species is common in California. *T. inquilina* is very closely related. *T. Eucalypti* Earle is a name assigned for purposes of distribution but no description was published. *Naucoria paludosa* Peck, described from the Catskills, is apparently identical, although the description calls for somewhat longer spores. *Tubaria contraria* Peck, also from New York, is apparently not distinct. All of the specimens listed below agree in having much closer lamellæ than European specimens obtained from Bresadola; in this particular they agree with *T. deformata* Peck.

Seattle, Washington, *Murrill;* Preston's Ravine, near Palo Alto, California, *Murrill & Abrams 1209, 1223;* Santa Cruz Mountains, California, *Dudley 130;* Stanford University, California, *Abrams 202, 203, Baker 157, 170, Dudley 76, 149, 167, 181, McMurphy 144, Nohara 4, 32, Miss Patterson 8, 42, 60.*

2. TUBARIA PALLESCENS Peck, Bull. Torrey Club **22**: 202. 1895

Pileus fleshy but thin, convex or nearly plane, sometimes slightly depressed in the center, glabrous, hygrophanous, brick-red when moist, yellowish or cream color when dry; lamellae broad, adnate or slightly decurrent, tawny-buff, becoming brownish-ferruginous; stem slender, hollow, yellowish, with white mycelium at the base; spores ellipsoid, $7.5 \times 4\,\mu$. Pileus 5 to 10 lines broad; stem 12–18 lines long, .5 to 1 line thick.

Described from specimens collected by McClatchie among sticks and leaves near Pasadena, California. Types not seen.

3. TUBARIA TENUIS Peck, Bull. Torrey Club **23**: 415. 1896

Pileus membranous, hemispheric or convex, obtuse or subumbilicate, glabrous, hygrophanous, reddish-cinnamon when moist,

cream color or pale-ochraceous when dry, either faintly striate or sulcate-striate on the margin; lamellae 1–2 lines wide, distant, ventricose, adnate or slightly decurrent, tawny-ochraceous; stem slender, flexuous, often uneven, hollow, pruinose at the top, downy at the base, pale-yellow or cream color; spores ellipsoid, $7.5 \times 5\,\mu$. Pileus 4–8 lines broad; stem 1–2 in. long, about 1 line thick.

Described from specimens collected by McClatchie among mosses on gravelly hillsides near Pasadena, California. Types not seen.

4. TUBARIA BREVIPES Peck, Rep. Harriman Alaska Exped. Crypt. 45. 1904

Pileus thin, convex, glabrous, ferruginous; lamellae broad, arcuate, distant, adnate or slightly decurrent, ferruginous; stem short, slender, glabrous, hollow, brown; spores ellipsoid, uninucleate, 10–12 μ long, 7–8 μ broad. Pileus 6–10 mm. broad; stem 6–14 mm. long, scarcely 1 mm. thick.

Described from specimens collected on the ground at Port Clarence, Alaska, *Trelease 562, 567*. The dried specimens are said to resemble *Omphalia Campanella* in color, but the spores are ferruginous, $10–12 \times 7–8\,\mu$.

7. GYMNOPILUS Karst. Hattsv. 400. 1879

Flammula (Fries) Quél. 1872. Not *Flammula* DC. 1818.

Several divisions of this genus have been proposed but none of them are satisfactory in the presence of the actual specimens. The veil, the attachment of the gills, the habitat of the plant, the shade of color in the spores, and the viscidity of the pileus may all be helpful in the separation of species, but they do not seem to furnish reliable and convenient characters for the segregation of the genus.

Most of the species here treated are plainly congeneric and rather difficult to separate from the descriptions alone. *G. decoratus* and *G. viridans* are imbricate-scaly; *G. echinulisporus* has noticeably roughened or echinulate spores; *G. laeticolor* is bright-red in color; *G. subflavidus* and *G. viridans* become green-spotted when handled; and *G. carbonarius* has peculiarly dark-colored gills when the spores mature.

1. **Gymnopilus laeticolor** sp. nov.

Pileus convex or somewhat conic to subexpanded, rarely umbonate, thin, cespitose, wood-loving, 3–5 cm. broad; surface smooth, glabrous, slightly viscid, hygrophanous, miniatous when young, becoming testaceous at the center and ochroleucous on the margin in mature plants; context dull-colored, bitterish; lamellae adnate, rather narrow, not crowded, ochraceous; spores ellipsoid, smooth, hyaline with a yellowish tint under a microscope, probably pale-ochraceous in mass, with one or two very brilliant nuclei, $7 \times 3\text{–}4\,\mu$; stipe equal, miniatous to ochroleucous below, white above, slightly moist and viscid, decorated with a few fibrils, the remains of a slight white veil, about 7 cm. long, 4–8 mm. thick.

Collected from the under side of a much decayed coniferous log in the forest near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 297, 505* (*type*). Related to *F. astragalina.*

2. **Gymnopilus decoratus** sp. nov.

Pileus convex to slightly depressed, at times umbonate, cespitose, wood-loving, 3.5–5 cm. broad; surface slightly viscid, the center imbricate-scaly with pale-bay scales, chestnut-colored on the umbo, the remainder of the surface cremeous, fading to white toward the margin; lamellae adnate or sinuate, isabelline to fulvous, rather broad but plane, not crowded, edges undulate; spores ellipsoid or ovoid, smooth, very pale melleous under a microscope, $5\text{–}6 \times 3.5\text{–}4\,\mu$; cystidia abundant, hyaline, conic, tapering to a short, narrow stalk, obtuse at the apex, $30 \times 12\,\mu$; stipe equal, rather tough, stuffed, white or yellowish, shaggy-fibrillose, 5–8 cm. long, 5–6 mm. thick; veil fibrillose, evanescent, remaining attached partly to the margin and partly to the stipe.

Collected abundantly on dead wood in open ground or in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 553* (*type*), *538, 619.* Also collected on dead wood in a dense fir forest at Glen Brook, Oregon, November 7, 1911, *W. A. Murrill 750.*

3. **Gymnopilus ornatulus** sp. nov.

Pileus convex to nearly plane, gibbous or umbonate, cespitose, 3 cm. broad; surface dry, slightly viscid when wet, fibrillose, flavo-melleous tinted with pale rose-brown, the latter color more conspicuous at the center; lamellae adnate, plane, broad, of medium distance, pallid when young, becoming pale-fulvous from the

spores; spores ellipsoid, smooth, pale-melleous under a microscope, 6×3.5–$4\,\mu$; stipe smooth, glabrous and cremeous at the apex, subconcolorous and shaggy-fibrillose below, 5 cm. long, 4 mm. thick.

Type collected on a bank by the roadside in Preston's Ravine, California, November 25, 1911, *W. A. Murrill* and *L. R. Abrams 1169*. Related to *G. decoratus,* but not conspicuously decorated, and without cystidia.

4. **Gymnopilus pallidus** sp. nov.

Pileus irregularly convex to plane, umbonate, 3–7 cm. broad; surface dull yellowish-gray, dry, smooth, glabrous, margin inflexed; context hyaline to grayish, watery, without characteristic taste or odor; lamellae adnexed, close, broad, falcate, grayish-white to fulvous; spores broadly ellipsoid, smooth, ochraceous-ferruginous under a microscope, fulvous in mass, 8–9×3.5–$4.5\,\mu$; stipe stout, pallid, hollow, fibrillose, 3–4 cm. long, 5–7 mm. thick; veil slight, evanescent, leaving no annulus.

Type collected on the ground under conifers at New Westminster, British Columbia, March 28, 1905, *Albert I. Hill 6.*

5. **Gymnopilus permollis** sp. nov.

Pileus convex, not umbonate, solitary, wood-loving, 7 cm. broad; surface viscid when young, becoming dry, smooth, glabrous, very soft and pliable to the touch, isabelline; lamellae remotely sinuate-adnate, rather distant, broad, becoming fulvous; spores ovoid, slightly one-sided, obliquely pointed, minutely roughened, melleous under a microscope, with one large nucleus, $11 \times 6\,\mu$; stipe equal, longitudinally striate, white, furfuraceous at the apex, fleshy, 8 cm. long, 8 mm. thick.

Type collected on dead wood in a coniferous forest near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 546.*

6. **Gymnopilus subflavidus** sp nov.

Pileus thin, conic or convex to expanded, umbonate when young, cespitose, wood-loving, 3–5 cm. broad; surface slimy, glabrous, smooth, melleous with fulvous center, becoming green-spotted when handled, margin entire, strongly incurved; lamellae citrinous to fulvous, sinuate or adnate, of medium breadth and distance; spores ellipsoid, rounded at the ends, smooth, melleous un-

der a microscope, $7–8 \times 3.5–4\,\mu$; stipe equal, cremeous above, pale-fulvous below, smooth, fibrillose, 4–7 cm. long, 5–8 mm. thick; veil slight, citrinous, membranous in young stages, soon breaking into fibrils and leaving no annulus.

Collected on dead stumps and logs in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 298 (type), 496.*

7. **Gymnopilus californicus** (Earle)

Flammula californica Earle, Bull. N. Y. Bot. Gard. **2**: 342. 1902.

Described from specimens collected by Baker in grassy places under trees, probably from buried wood, at Stanford University, December 5, 1901.

Stanford University, California, *Baker 167, Miss Patterson 75.*

8. **Gymnopilus Hillii** sp. nov.

Pileus slightly convex, umbonate, cespitose, 2–4 cm. broad; surface smooth, dry, glabrous, raw-sienna, brown to buff at the center; margin thin, even; context very thin, yellowish, mucilaginous to the taste, odor not characteristic; lamellae adnate or emarginate, crowded, inserted, rather broad, falcate, yellowish to fulvous; spores ovoid, smooth, fulvous, $6 \times 3.5–4\,\mu$; stipe flexed because of its lateral position on the trunk, equal, glabrous, umber-brown to slightly blackish below, lighter above, hollow, 2.5–4 cm. long, 2–5 mm. thick.

Type collected on rotten logs and stumps at New Westminster, British Columbia, April 23, 1905, *Albert I. Hill 7.*

9. **Gymnopilus fulvellus** (Peck)

Flammula fulvella Peck; Macoun, Fur Seals North Pac. Pt. III. 584. 1899.

Pileus thin, convex or nearly plane, glabrous, subtawny, the margin deflexed or incurved, flesh whitish; lamellae thin, subdistant, adnate or slightly decurrent, somewhat tawny, inclining to ochraceous-tawny; stem equal, solid, fibrillose or fibrillose-squamulose, colored like the pileus; spores ellipsoid, $12.5 \times 7.5\,\mu$.

Pileus 1.2–2.4 cm. broad; stem about 2.5 cm. long, 3–4 mm. thick.

Described from dried specimens collected on low ground, St. Paul Island, Bering Sea, September, 1896, by J. M. Macoun.

10. **Gymnopilus penetrans** (Fries)

Flammula penetrans (Fries) Quél. Champ. Jura Vosg. 233. 1872.

Seattle, Washington, *Murrill 250, 361, 383, 411, 433, 455, 481, 486, 635, 693;* Glen Brook, Oregon, *Murrill 746, 767;* Searsville, California, *F. J. Jack 92;* Marin County, California, *Miss Eastwood 39;* Stanford University, California, *Abrams & McMurphy 65*.

11. **Gymnopilus sapineus** (Fries)

Flammula sapinea (Fries) Quél. Champ. Jura Vosg. 98. 1872.

This species differs little from *G. penetrans.* Fries combined the two in his *Systema,* but later separated them again. The points of difference as he states them and also figures them are, as follows: *G. penetrans* is glabrous, with sinuate gills, which become fulvous-spotted, and a long stipe with white base and reddish-brown interior. *G. sapineus* is slightly floccose-squamulose, becoming rimose, with adnate gills, and short stipe not white at the base and yellow within. Cooke's figures of *G. sapineus* seem to agree well with Fries' figures of *G. penetrans.*

Salem, Oregon, *M. E. Peck.*

12. **Gymnopilus spumosus** (Fries)

Flammula spumosa (Fries) Quél. Ench. Fung. 70. 1886.

Seattle, Washington, *Murrill 605.*

13. **Gymnopilus spinulifer** sp. nov.

Pileus convex, umbonate, at length expanding and losing the umbo, scattered or clustered, 3.5–8 cm. broad; surface smooth, glabrous, viscid, light-yellow with bay center, margin entire; context cremeous, without characteristic taste or odor; lamellae adnate or very slightly sinuate, plane, of medium breadth and distance, yellowish to ferruginous; spores ovoid to ellipsoid, smooth, pale-melleous under a microscope, dark-fulvous in mass; cystidia hyaline, flask-shaped, with short, narrow neck and long stalk, $70 \times 15\,\mu$; stipe equal, hollow, subglabrous, with conspicuous mycelium at the base, yellowish-white or tinted with bay; veil arachnoid, whitish, leaving a small ring of fibrils near the apex of the stipe.

Type collected on the ground among leaves under redwoods near Portola, California, January 4, 1903, *James McMurphy 10.* Also collected under redwoods near Jasper Ridge, California, January 11, 1912, *James McMurphy 143.* Both of these collections were accompanied by excellent field notes and sketches. Specimens without notes but recognized by the characteristic cystidia are, as follows: Mill Valley, California, under redwoods, December 28, 1902, *Alice Eastwood 25;* Santa Cruz Mountains, under redwoods, December, 1895, *W. R. Dudley 107, 126.*

14. **Gymnopilus echinulisporus** sp. nov.

Pileus convex to plane, at length depressed, slightly umbonate when young, wood-loving, reaching 7 cm. broad; surface nearly smooth, moist, glabrous, shining, ferruginous at the center, fulvous on the margin, paler in dry weather, when it is usually darker at the center than on the margin; margin folded or fissured, strongly incurved on drying; lamellae sinuate-adnate with a tooth, broad, slightly ventricose, ferruginous-isabelline to fulvous; spores broadly ovoid to subglobose, conspicuously and densely echinulate, ferruginous under a microscope, $6–9 \times 5–6\,\mu$; stipe equal, or enlarged just at the base, longitudinally striate, whitish to isabelline-ferruginous, about 6 cm. long, 1.3–1.6 cm. thick; veil apparently wanting, even in quite young plants.

Type collected on dead wood in moist woods at Mill City, Oregon, November 9, 1911, *W. A. Murrill 815.* Also collected on dead wood in woods near Corvallis, Oregon, November 6–11, 1911, *W. A. Murrill 939.*

15. **Gymnopilus vialis** sp. nov.

Pileus convex to expanded, at length depressed, splitting radially at the margin, wood-loving, 5 cm. broad; surface dry, glabrous, smooth, at length rimose, dark flavo-luteous with bay center or the entire surface bay; lamellae adnate, ventricose, broad, rather close, citrinous to ferruginous-fulvous; spores ellipsoid, rounded at the ends, smooth, melleous under a microscope, $7 \times 3.5\,\mu$; stipe equal or inflated, solid or hollow, citrinous, fibrillose, especially at the top, where a slight trace of the fugacious veil remains, 5 cm. long, 1–1.5 cm. thick.

Type collected on a railway tie in the town of Corvallis, Oregon, November 6–11, 1911, *W. A. Murrill 969.*

16. **Gymnopilus subcarbonarius** sp. nov.

Pileus convex to expanded, rarely umbonate, rather thin, gregarious, 3–4 cm. broad; surface smooth, glabrous, very viscid, red to bay, yellow on the margin, sometimes darker at the center; lamellae adnate or sinuate, not crowded, rather narrow, inserted, pale-yellow to ochraceous or fulvous; spores ellipsoid, smooth, melleous under a microscope, fulvous in mass, $7 \times 3–4\,\mu$; stipe short, somewhat enlarged below, white, scaly, hollow, 3–4 cm. long, 4–8 mm. thick; veil fibrillose, evanescent, not leaving an annulus.

Type collected on the ground at Berkeley, California, January 31, 1911, *R. A. Harper 6*. Closely allied to *G. carbonarius*, but differing in the color of the gills.

17. **Gymnopilus carbonarius** (Fries)

Flammula carbonaria (Fries) Quél. Champ. Jura Vosg. 232. 1872.

For a description and colored figure of this species, see MYCOLOGIA for July, 1912. It usually occurs in charred ground and is of a nearly uniform reddish-brown color, with lamellae yellowish-white to dark-ochraceous or pale-fuscous and spores ferruginous, $7 \times 3–4\,\mu$. *G. spumosus* occurs on naked ground and is yellowish-brown with reddish-brown center, and has yellow to ferruginous lamellae, with ochraceous spores that are slightly larger than those of *G. carbonarius*.

Seattle, Washington, *Murrill 263, 325, 627, 641;* Salem, Oregon, *M. E. Peck;* La Honda, California, *Murrill & Abrams 1259;* Presidio, California, *Harper 69;* Stanford University, California, *Abrams 205, Miss Patterson 19.*

18. **Gymnopilus viscidissimus** sp. nov.

Pileus conic, not fully expanding, gregarious, 2 cm. broad; surface smooth, glabrous, very slimy, isabelline with an incarnate tint, usually a little darker at the center; lamellae sinuate-adnate, broad, ventricose, rather crowded, pale-isabelline, becoming darker with age; spores ovoid, pointed, often one-sided, very pale with a fuscous tint under a microscope, dark-fulvous in mass, $7 \times 3–4\,\mu$; stipe equal or slightly larger below, stuffed, whitish, furfuraceous above, fibrillose below, rather tough, 6 cm. long, 3.5 mm. thick.

Type collected among mosses and humus on the ground in low woods at Mill City, Oregon, November 9, 1911, *W. A. Murrill 833*. Also collected in a peat bog near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 347*.

19. **Gymnopilus latus** sp. nov.

Pileus convex to plane, not umbonate, gregarious, wood-loving, reaching 9 cm. broad; surface glabrous, shining, viscid, radiate-lineate, ferruginous-fulvous at the center, ochroleucous on the margin; context rather thin, mild to the taste; lamellae sinuate or adnate, pallid to fulvous, plane, not crowded, rather narrow; spores ellipsoid, rounded at the ends, smooth, melleous under a microscope, $6 \times 3.5\,\mu$; stipe equal, or slightly larger below, dry, smooth, subglabrous, fleshy, white or somewhat yellowish, with yellow or orange mycelium at the base, 5–7 cm. long, 1–1.3 cm. thick; veil pale-yellow, membranous in young sporophores, soon breaking into fibrils and disappearing.

Type collected on a dead deciduous log in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 650*.

20. **Gymnopilus viridans** sp. nov.

Pileus thick, convex, with large umbo, cespitose, wood-loving, reaching 8 cm. broad; surface dry, ochraceous, becoming green-spotted when handled, with conspicuous light-bay scales sparsely scattered except at the center, where they are rather close together; lamellae adnate, broad, crowded, isabelline to ferruginous, edges undulate; spores ellipsoid, obliquely pointed at one end, smooth, ferruginous in mass, $7 \times 3.5\,\mu$; stipe larger below, longitudinally streaked, concolorous, reaching 6 cm. long, and 2 cm. thick.

Type collected on a burnt coniferous log in an open field near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 657*. Also collected in clusters by the roadside near woods at Green River, King County, Washington, June, 1891, *A. M. Parker 1*. In habit and appearance, the plant resembles *Lentinus lepideus* and *Pholiota aeruginosa*.

21. **Gymnopilus foedatus** (Peck)

Hebeloma foedatum Peck, Bull. Torrey Club **22**: 202. 1895.

Described from specimens collected by McClatchie on the streets of Pasadena, California. Similar to *G. carbonarius* in appearance, but with much darker spores.

Pasadena, California, *McClatchie;* Claremont, California, *Baker.*

8. PHOLIOTA (Fries) Quél. Champ. Jura Vosg. 91. 1872

1. PHOLIOTA MARGINATA (Batsch) Quél. Champ. Jura Vosg. 94. 1872

Muir Glacier, Alaska, *Trelease 525.* Specimens not seen, but it is doubtful if they represent the plant originally described by Batsch.

2. PHOLIOTA UNICOLOR (Vahl) Gill. Champ. Fr. 1: 436. 1878

This species is very abundant on dead wood in the Pacific Coast region. It differs from the plants usually known as *P. marginata* in having broader gills and larger spores, the latter measuring 8–10 × 5–6 μ.

Seattle, Washington, *Murrill 254, 264, 278, 350, 392, 474, 590, 690, 697;* Mill City, Oregon, *Murrill 820;* Corvallis, Oregon, *Murrill 977, 1017;* Preston's Ravine, California, *Murrill & Abrams 1232, 1237;* La Honda, California, *Murrill & Abrams 1246, 1282, 1305;* Yakutat Bay, Alaska, *Trelease 520.*

3. **Pholiota subnigra** sp. nov.

Pileus very small for the genus, convex, slightly umbonate, solitary, 1.3 cm. broad; surface smooth, glabrous, slightly viscid, uniformly fuliginous, except on the immediate margin, where it is hoary on account of a pubescence originating from the veil; lamellae sinuate-adnate, ventricose, broad, not crowded, becoming fulvous, the edges remaining whitish; spores irregularly ellipsoid, pointed at the base, 1–2-guttulate, smooth, melleous under a microscope, 10–11 × 4–5 μ; stipe equal, cylindric, pallid, fleshy, solid, rough with short, soft, whitish, conic scales pointing upward, 2 cm. long, 2.5 mm. thick; veil ample, white, membranous, leaving a large, superior, persistent annulus.

Type collected on the ground in woods, attached to a small buried root, near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 380.*

4. PHOLIOTA CANDICANS (Bull.) Schröt. Krypt. Fl. Schles. 3[1]: 608. 1889

Pholiota praecox (Pers.) Quél. Champ. Jura Vosg. 91. 1872.

A description and colored figure of this common eastern species were published in MYCOLOGIA for July, 1911. I found it only twice on the Coast.

Open grassy ground, Seattle, Washington, *Murrill 337;* mixed woods, Corvallis, *Murrill 1021;* Woodside, California, *E. B. Copeland;* Yakutat Bay, Alaska, *Trelease 502, 514, 517.*

5. PHOLIOTA ANOMALA Peck, Bull. Torrey Club **22**: 202. 1895

Pileus at first hemispheric or subconic, then convex, glabrous, hygrophanous, broccoli-brown when moist, pale-yellow or cream-color when dry; lamellae adnate or slightly decurrent, subarcuate, pale becoming brownish-ferruginous, often white on the edge; stem cavernous or hollow with irregular transverse partitions, sometimes containing a cottony tomentum, whitish, with a slight evanescent annulus; spores ellipsoid, 8–10 × 6–7 μ.

Pileus 1.5–3.5 cm. broad; stem 4 cm. long, 2–6 mm. thick.

Described from specimens collected by McClatchie among sticks and leaves on the ground near Pasadena, California, in January. The species suggests *Tubaria.*

6. **Pholiota washingtonensis** sp. nov.

Pileus convex to applanate or slightly depressed, thin, gregarious, cespitose at times, reaching 10 cm. broad; surface hygrophanous, smooth, glabrous, more or less rugose, pale-isabelline, dull-fulvous at the center, margin striate, rather irregular; lamellae adnate with a tooth, broad, not crowded, avellaneous, becoming dark-fulvous; spores irregularly ellipsoid, often plane on one side, pointed obliquely at the base, smooth, ferruginous under a microscope, with a single large nucleus, 11 × 6 μ; stipe fleshy, streaked, equal or tapering upward, white at the apex, brownish and fibrillose below, 6–8 cm. long, 0.5–1.5 cm. thick; veil ample, white, membranous, leaving a large, superior, persistent annulus.

Collected on the ground in low woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 333* (*type*), *563, S. M. Zeller.*

7. **Pholiota McMurphyi** sp. nov.

Pileus convex to subexpanded, rather thick and fleshy, scattering, 4–8 cm. broad; surface slimy-viscid, smooth, glabrous, fulvous at the center, greenish-yellow on the margin; context whitish, without characteristic taste or odor; lamellae adnate, slightly sinuate, broad, plane, close, becoming fulvous with a bay tint; spores ellipsoid, pointed at times, ferruginous under a microscope, rough with tubercles or short papillae, averaging $12 \times 7 \mu$; stipe cylindric, equal, yellowish-white, solid or slightly spongy within, the surface rough with projecting ridges as though furnished with several scanty rings, 4–6 cm. long, 1–2 cm. thick; veil white, fibrillose even when young, leaving an annulus consisting of a few inconspicuous fibrils.

Type collected among leaves under oak trees near Searsville Lake, California, December 28, 1902, *James McMurphy 11.*

8. **Pholiota albivelata** sp. nov.

Pileus thin, convex to plane, slightly umbonate, solitary, terrestrial, reaching 5.5 cm. broad; surface very slimy-viscid, isabelline tinted with rose, resembling the color of some species of *Gomphidius,* the umbo slightly darker; lamellae adnate or slightly sinuate, arcuate, not crowded, becoming fulvous, edges pallid; spores ellipsoid, smooth, melleous under a microscope, 1–2-guttulate, $9–11 \times 4–5 \mu$; stipe milk-white throughout, glabrous and slightly smaller above the annulus, shaggy at the center, fibrillose becoming subglabrous and rarely yellowish at the base, solid, about 8 cm. long, 7 mm. thick above, 10 mm. thick below; annulus above the middle of the stipe, very ample, milk-white, fixed, persistent, colored above by the spores and furrowed by the lamellae.

Type collected on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 593.* Also collected in the same region, *S. M. Zeller 88;* at Glen Brook, Oregon, November 7, 1911, *W. A. Murrill 741;* and at Newport, Oregon, November 13, 1911, *W. A. Murrill 1048.*

9. PHOLIOTA VENTRICOSA Earle, Bull. N. Y. Bot. Gard. **2**: 341. 1902

Pileus very convex, obtuse, cespitose, wood-loving, reaching 8 cm. in diameter; surface moist, ferruginous or luteous to dark-ferruginous or latericious, slightly fibrillose-striate, with frag-

ments of the cream-colored, rather well-developed veil clinging to the margin and forming a small annulus near the apex of the stipe; lamellae sinuate to adnate with decurrent tooth, melleous to ferruginous, of medium breadth and distance, edges very irregularly repand and toothed; spores ellipsoid or ovoid, ferruginous, rough with conspicuous granular or short-papillate protuberances, $8–9 \times 4–5\,\mu$; stipe bulbous, hollow, streaked, fibrillose-striate, cream-colored above, ferruginous below, $6–9 \times 1–2$ cm.

Described from specimens collected at the base of pine trees at Stanford University, California, *Baker 122*. Found on logs of *Pseudotsuga* at Seattle. Closely related to *Gymnopilus*.

Seattle, Washington, *Murrill 575, 618, Zeller 84, 118, A. M. Parker 2;* Glen Brook, Oregon, *Murrill 748;* Searsville Lake, California, *McMurphy 104;* Stanford University, California, *McMurphy 131, Baker 122.*

9. HYPODENDRUM Paulet, Icon. 75. 1793

1. **Hypodendrum flammans** (Batsch)

Agaricus flammans Batsch, Elench. Fung. 87. *f. 30.* 1783.

Pileus convex, fleshy, cespitose, 2–2.5 cm. broad; surface luteous, decorated with a few floccose, flavous scales, which appear to fall away with age; veil large, flavous, floccose-fibrous; lamellae adnate; spores subhyaline, ellipsoid, $4 \times 2\,\mu$, not mature; stipe rough with floccose, flavous scales, fistulose, firm, 3 cm. long, 7 mm. thick.

Growing from a knothole near the base of a living trunk of *Abies*. The specimens are, unfortunately, immature.

Glen Brook, Oregon, *Murrill 770.*

2. **Hypodendrum limonellum** (Peck)

Agaricus (Pholiota) limonellus Peck, Ann. Rep. N. Y. State Mus. **31**: 33. 1879.

Corvallis, Oregon, *Murrill 951.* Growing from a crack in a standing dead trunk of *Crataegus* in woods.

3. **Hypodendrum oregonense** sp. nov.

Pileus convex, at first circular, becoming one-sided from its position, not umbonate, thick and fleshy, cespitose, reaching 5 cm.

or more broad; surface dry, smooth, glabrous, flavous-ochraceous, margin strongly incurved; context thick, cremeous; lamellae adnate, yellowish to yellowish-brown, becoming fulvous, strongly interveined, distant, edges irregular; spores ellipsoid, smooth, ferruginous, uniguttulate, $7–9 \times 4–5 \mu$; stipe dry, large, varying in shape from ventricose to enlarging upward, yellowish above, fulvous below, with small, scattered, unicolorous scales pointing upward; veil large, irregular, yellowish-white, leaving an irregular, superior annulus.

Type collected on a decayed spot in a living willow trunk in a meadow near Glen Brook, Oregon, November 7, 1911, *W. A. Murrill 754*.

10. LOCELLINA Gill. Champ. Fr. **1**: 428. 1878

Locellina stercoraria (Peck)

Pluteus stercorarius Peck, Bull. Torrey Club **22**: 488. 1895.
Locellina californica Earle, Bull. N. Y. Bot. Gard. **3**: 299. 1904.

Stanford University, California, *Baker 382, Abrams 2, Nohara 47, M. T. Cook 9, Miss Patterson 45;* Madera Creek, California, *McMurphy 42;* New Westminster, British Columbia, *A. I. Hill 9*.

NEW COMBINATIONS

For the benefit of those using Saccardo's nomenclature, the following new species in the above article are recombined, as follows:

GYMNOPILUS DECORATUS = **Flammula decorata.**
GYMNOPILUS ECHINULISPORUS = **Flammula echinulispora.**
GYMNOPILUS HILLII = **Flammula Hillii.**
GYMNOPILUS LAETICOLOR = **Flammula laeticolor.**
GYMNOPILUS LATUS = **Flammula lata.**
GYMNOPILUS ORNATULUS = **Flammula ornatula.**
GYMNOPILUS PALLIDUS = **Flammula pallida.**
GYMNOPILUS PERMOLLIS = **Flammula permollis.**
GYMNOPILUS SPINULIFER = **Flammula spinulifer.**
GYMNOPILUS SUBCARBONARIUS = **Flammula subcarbonaria.**
GYMNOPILUS SUBFLAVIDUS = **Flammula subflavida.**
GYMNOPILUS VIALIS = **Flammula vialis.**
GYMNOPILUS VIRIDANS = **Flammula viridans.**
GYMNOPILUS VISCIDISSIMUS = **Flammula viscidissima.**
HYPODENDRUM OREGONENSE = **Pholiota oregonensis.**
VENENARIUS PANTHERINOIDES = **Amanita pantherinoides.**
VENENARIUS PRAEGEMMATUS = **Amanita praegemmata.**
VENENARIUS UMBRINIDISCUS = **Amanita umbrinidisca.**

NEW YORK BOTANICAL GARDEN.

POLYSTICTUS VERSICOLOR AS A WOUND PARASITE OF CATALPA

Neil E. Stevens

(With Plates 74 and 75, Containing 4 Figures)

The wood rot of living catalpa caused by *Polystictus versicolor* is the only really serious disease of the catalpa yet reported. *Polystictus versicolor* is, of course, one of the most common wood-rotting saprophytes, but as was pointed out by von Schrenk (8) in 1902, it becomes on the catalpa a dangerous wound parasite, growing with great rapidity in living trees, spreading up and down the trunk from the point of infection, out into the branches and even into the roots (8, p. 53). On living trees the fungus produces sporophores in great abundance, but is rarely found fruiting on dead catalpa; a fact which apparently led von Schrenk to the conclusion that *P. versicolor* is unable to grow on dead catalpa wood and that even when growing in a living tree stops its growth when the tree is cut (8, p. 54). As the writer has shown in a recent paper (7), however, *Polystictus versicolor* may continue to grow on dead catalpa wood and under favorable conditions may produce normal sporophores in considerable quantity.

The report of von Schrenk on the diseases of the hardy catalpa was based largely on observations in two large plantations in Crawford County, Kansas, the Hunnewell and Farlington plantations. In fact, these two plantations, together with the other large plantations in the eastern portion of Kansas, have served as the basis for most of the work done in this country on the artificial cultivation of the hardy catalpa. During the past year (1911–1912) the writer has investigated the wood rots of the catalpa in this region, with special reference to second growth stands. In the course of this work it has become evident that coppice shoots on partly decayed stumps are much less readily infected than are branches of a partly decayed trunk, and that

there is an apparently constant relation between the presence of a decayed area in the trunk and the formation of tyloses in the outer wood. While the data on these points are by no means so complete as to make possible wholly satisfactory explanations of the conditions mentioned, the observations already made seem of sufficient interest to make their publication worth while.

INFECTION OF COPPICE SHOOTS FROM DISEASED STUMPS

When the large plantations referred to above were first cut over, the trees were from twenty to twenty-four years old. At that time many of the stumps were rotten at the center. Undoubtedly they were affected in most cases by *Polystictus versicolor,* for many of the trees on both the Farlington and Hunnewell plantations were seriously decayed by this fungus at the time of cutting, and in certain portions of these plantations many of the stumps are now bearing numerous sporophores of this species.

Yet sprouts from these partly rotted stumps, even from those which bear sporophores, show no external evidences of fungus infection and are as well developed as those from sound stumps. Six-year old sprouts on partly rotted stumps are fully as large as those of the same age on sound stumps and bear as many seed pods. To determine whether these sprouts were actually free from fungus infection or whether the fungus was present and would finally result in the weakening and death of the sprout, the writer spent several days in a study of the second growth at the Hunnewell plantation. Fortunately for this work, eighty acres of six-year old second growth was sprouted only a few weeks before his visit (March, 1912), and the sprouts were still lying where they had been cut.

A careful examination of this eighty-acre tract showed that while only a very few of the shoots from partly decayed stumps showed any external evidence of fungus infection, a large proportion were rotted at the heart. On the other hand, practically none of the shoots from sound stumps showed decayed areas. In one forty-acre tract nearly two hundred stumps were counted which bore sporophores of *Polystictus versicolor* and the sprouts from nearly all of these showed rotten hearts. On fifteen large

decayed stumps which bore six or more good sized sprouts, every sprout showed a considerable decayed area. In the entire eighty acres, however, only three sprouts were found which bore sporophores.

There can be little question that the decayed sprouts were infected from the stump. In the great majority of cases, the sprouts showed no injury through which the fungus might have entered, and the decayed area was always largest at the base of the sprout. Moreover, no such decayed areas were found in sprouts from sound stumps. The decayed area generally occupied the center of the sprout and extended up from the base for some distance, usually less than two feet and very rarely as much as three. Figs. 1 and 2 show two sections through an unusually large sprout from a stump which bore a large number of sporophores. The section shown in fig. 2 was cut about six inches above the stump and that in fig. 1 two feet above the stump. These figures show that the growth of the sprout had been very rapid, much more rapid in this case than in the majority of the sprouts from sound stumps, and that the action of the fungus was limited thus far to a comparatively small portion of the sprout. How rapid the further progress of the fungus may be cannot, of course, be determined at present, but it is certain that this fungus frequently spreads much more than two feet a year in living catalpa trees. (See 8, p. 53.)

Why decay had not progressed further is a most interesting question. There can be no doubt that the fungus both in the stump and in the sprout was alive and in a vigorous condition at the time the trees were examined. Pieces of the rotten wood placed in a moist chamber showed in a few days a dense growth of characteristic mycelium. Moreover, it is entirely probable that the stumps which produced the rotten sprouts were themselves infected before the trees were cut. Many of the stumps certainly were affected when the plantation was cut over and it is difficult to suppose that the fungus died in these stumps and that they or other stumps were infected later. Infection of sound catalpa wood does not easily occur and the stumps in question were most rotten at the center, exactly the condition found in the stumps of badly rotted trees.

It is possible, of course, that the progress of the fungus in these shoots was slower than in older trees. But even if considerable allowance is made for this assumption, it seems more than probable that these shoots did not become infected for some time, probably several years, after they started. That *Polystictus versicolor* is capable of living for that length of time even without much growth cannot be doubted, for Bayliss (1, p. 20) has proved that the mycelium of this fungus can retain its vitality in a dried stick for at least four years. Observations at Soldier, Kansas, indicate clearly that *Polystictus versicolor* is capable of attacking seedlings even younger than these sprouts. Certainly the fungus spreads rapidly enough from the trunk of a tree into its branches; and it readily attacks and fruits on one-year old sprouts around the base of a living tree.

It is not entirely clear, therefore, why these coppice shoots were not attacked and killed much earlier; but it seems possible that this temporary "immunity" may be due to the rapid growth of the sprouts. Both Hartig and Sorauer have cited examples of wound parasites which, although capable of causing the decay of woody portions growing at an ordinary rate, are unable to attack *rapidly* growing parts. Hartig (3) states that in the case of an oak attacked by *Armillaria mellea,* one may readily observe that the parasite has not developed equally, but usually toward one side. According to him, the development is arrested when the fungus comes to a region directly under the influence of a vigorous shoot.

Sorauer (6, p. 192) discusses the parasitism of *Nectria cinnabarina* and states that this fungus is apparently unable to attack sound, rapidly growing tissue of the host. This writer has observed in the case of small trunks of *Acer Negundo* attacked by *Nectria cinnabarina,* that in the spring the progress of the fungus is stopped by the more vigorous growth of the wood. Sorauer further states that in larger trunks where a sound side shoot has developed, the fungus in the main trunk kills the tissue up to the part which is under the influence of the vigorous side shoot and there remains stationary. It seems possible that something like this occurs in the case of diseased catalpa stumps which have given rise to vigorous coppice shoots. That is to say, that the

fungus may be held in check for a time by the rapid growth of the new tissues.

An examination of such stumps as that shown in fig 4, which is typical of a number found on the Hunnewell plantation, lends support to this idea. This photograph was taken from a section through the base of a stump which bore sporophores of *Polystictus versicolor* and which had produced a sprout of average size. It will be noted that the fungus has destroyed practically all of the wood of the original stump but that the second growth is as yet untouched. That the fungus was in a vigorous condition was proved by placing the stumps in a moist chamber, where mycelium developed on the cut surface in a few days.

Unfortunately, no complete data are at hand by which the rate of growth of catalpa coppice may be compared with that of seedlings. For the first few years the growth of coppice shoots greatly exceeds that of seedlings, but whether this accelerated growth is sufficient to check the progress of the fungus cannot, of course, be determined at present. It is apparent, however, from an unpublished report on the catalpa plantation at Farlington, made in 1911 by Mr. Charles A. Scott, Kansas State Forester, that in this plantation, at least, the accelerated growth of the coppice shoot does not last more than three or four years and that the succeeding growth may be even less than that of normal seedlings. A comparison of his data with that given by Hall (2) for the same plantation in 1902 shows that second growth dominant trees nine years old do not exceed in height average seedling trees of the same age. As the data also show that the rate of growth of second growth trees was considerably greater than that of seedlings during the first three of four years, the subsequent growth of the second growth trees must have been enough slower to make up for what they gained in the first few years.

It is by no means certain that there is any relation between the fact that the shoots grow more rapidly for the first few years and that they are apparently for a time immune to the attacks of the fungus, but the probability is at least great enough to make continued observation on this point worth while. At any rate, the length of time for which the accelerated growth of coppice

shoots continues, and the limited extent of the decayed areas in six-year old sprouts harmonize readily with the idea that these shoots were not attacked until the most rapid growth had ceased. This makes the assumption that there was some causal connection between the rapid growth and the temporary immunity seem not improbable.

Coriolellus Sepium.—Although no other dangerous fungus parasites of the hardy catalpa have been reported, the writer has found several species growing to some extent both on living and on dead catalpa (7, p. 116). Next to *Polystictus versicolor,* the species which the writer has most frequently found fruiting on catalpa stumps is *Coriolellus Sepium* (Berk.) Murrill (*Trametes Sepium* Berk.). While this fungus was not present in sufficient abundance to be considered at all important from an economic standpoint, it is interesting to note that the relation of the fungus in the stump to the coppice shoot was apparently the same as in the case of *Polystictus versicolor.* That is, the fungus although well developed and in vigorous condition in the stump, does not readily attack the shoot. Fig. 3 shows a section through the base of a stump which bore numerous sporophores of *Coriolellus Sepium* and had given rise to a six-year old coppice shoot of average size. It will be noted that the fungus had destroyed a considerable portion of the stump but had not entered the sprout.

Development of Tyloses near a Decayed Region

In sections made for the purpose of studying the effect of the fungus on the wood, an interesting relation between the presence of the fungus and the occurrence of tyloses was noted. This relation was observed in the wood of both seedling trees and coppice shoots; and was so striking and constant that it seems that there must be some causal connection and that the presence of a decayed region in a trunk may have a direct bearing on the development of tyloses.

Tyloses were present to some extent in all pieces of catalpa examined but a marked difference was evident between the number of tyloses present in sound and in infected wood. The difference appears both in the number of tyloses present in each

annual ring, and in the age of the wood when tyloses first appear. In normal catalpa wood tyloses are found almost exclusively in the larger vessels of the spring wood, and even in these they are more or less scattering, many of the vessels containing no tyloses and others being only partly filled. Tyloses first appear in the second ring from the bark, that is, they are found to a very limited extent in two-year old wood. They are more numerous, of course, in wood which is three- or four-years old, but do not occur in sufficient numbers to hinder very seriously the flow of water.

When the outer portion of a trunk which is rotten at the heart is examined, however, tyloses are found filling practically every vessel of the spring wood and occurring to a considerable extent in the vessels of the summer wood. Moreover, there are practically as many tyloses in the two-year old wood as in the five- or six-year old wood. This is the case even when the rotten portion of the trunk is at some little distance from the two-year old wood, often as much as four or five annual rings. Such a condition means, of course, that even the two-year old wood in badly diseased trees is of practically no use for water conduction. It seems probable that the presence of these tyloses and the consequent obstruction to the flow of water would result in the earlier death of the parenchyma cells in these outer annual rings. It seems possible also that these outer rings would then be more readily attacked by the normally saprophytic *Polystictus versicolor,* and that the formation of tyloses may play some part in the invasion of the sap wood by the fungus.

It would, of course, be unsafe to assume without further proof that this markedly increased development of tyloses is due to the fact that part of the trunk is decayed. But Hartig (4, p. 235) observed that "when the wood of a dicotyledonous tree is exposed by a wound the vessels become completely plugged up by tyloses," and there is considerable resemblence between this condition and that found by the writer in partly rotted catalpa trunks. If, as is generally believed (5), the formation of tyloses occurs when the pressure in the vessels becomes less than that of the adjacent parenchyma cells, then anything that reduces the pressure in the vessels while the parenchyma cells are alive

would tend to increase the number of tyloses. Whether the presence of a considerable decayed area would occasion any reduction of the pressure in the vessels and thus result in the great increase in the number of tyloses which occurs, is by no means certain but it seems to offer the only explanation of this interesting condition.

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EXPLANATION OF PLATES LXXIV AND LXXV

Figs. 1 and 2. Sections of a large six-year-old catalpa sprout on a stump which bore sporophores of *Polystictus versicolor*. The section shown in fig. 1 was taken two feet from the stump, and that shown in fig. 2, six inches from the stump. × ¾.

Fig. 3. Section of the base of a small catalpa stump which bore sporophores of *Coriolellus Sepium* and had produced a normal coppice shoot. × ¾.

Fig. 4. Section of the base of a catalpa stump which bore sporophores of *Polystictus versicolor* and had produced a normal six-year-old coppice shoot. × ½.

POLYSTICTUS VERSICOLOR ON CATALPA

POLYSTICTUS VERSICOLOR ON CATALPA

TYPE STUDIES IN THE HYDNACEAE[1]— I. THE GENUS MANINA

HOWARD J. BANKER

The segregation of fungal forms proposed under the generic name *Manina* was first established with practically its present conception and limitations by Scopoli in 1772 in a work entitled "Dissertationes ad scientiam naturalem pertinentes." This work was a small treatise covering, as its title implies, a wide range of subjects and was in fact only part of a still wider ranging series of papers. The greater part of the work is devoted to subjects in mineralogy, but it also contains a short paper entitled "Plantae subterraneae descriptae et delineatae." This latter paper is often cited by the older mycologists but always simply as "Plantae subterraneae," which as we see is part of a subtitle, and the incomplete citation has made it difficult to locate the original paper. The work in which it appears is rare and a copy was found only in the library of the British Museum. Although the work is obscure and somewhat inaccessible at present, it appears to have been well known to the older mycologists and is of special interest to us because of its containing one of the earliest truly natural segregations out of that assemblage of plants known today as the Hydnaceae.

The name *Manina,* diminutive from the Italian *Mano,* a hand, was first proposed by Adanson in the "Familles des Plantes" **2**: 5. 1763. Adanson published the name citing in connection therewith "coralloides Micheli *Pl. 88. f. 2 and 6.*"

Micheli's genus as shown both by his description and figures was undoubtedly the branched forms of our more modern genus *Clavaria.* Adanson's genus, therefore, if it were to be recognized, would properly belong to the family of the Clavariaceae, but the genus was not established according to the code here followed.

Scopoli took up Adanson's name and republished it in his

[1] Investigation prosecuted with the aid of a grant from the Esther Herrman Research Fund of the New York Academy of Science.

"Dissertationes ad scientiam Naturalem pertinentes" 97. 1772, where he used it as the name of a new genus and formed several binomial combinations, thus establishing the genus according to our present rules. The first species in this new genus was named by Scopoli *Manina cordiformis* which, therefore, becomes its type. Both the description and the illustration of this species show it to be clearly and unquestionably the species which has long been familiar to mycologists as *Hydnum Erinaceus* Bull. The species associated with this in the genus *Manina* by Scopoli are also the same type of forms as we have usually associated with *H. Erinaceus* and which have been likewise segregated by later mycologists under various names. The genus *Manina* Scop. is, therefore, both technically and logically the genus to which should be referred *Hydnum Erinaceus* Bull. = *Manina cordiformis* Scop. and its natural congeners *Hydnum coralloides* Scop., *H. Caput-ursi* Fr., etc.

In a previous paper[2] the writer referred this group of species to the genus *Hericium* Persoon, "Neues Mag. für die Bot." 1: 109. 1794. The latter was based on the single species *Hydnum coralloides* Scop. and now becomes a metonym of *Manina* Scop. It was strongly suspected at the time that the latter name had priority but it was impossible then to confirm the fact. As later treated by Persoon, *Hericium* was congeneric with *Manina*.[3]

The genus *Medusina* Chevallier, "Fl. Gen. des Env. de Paris." 278. 1826, was based on *M. patula* Chev. = *Manina cordiformis* Scop. and is, therefore, a typonym of *Manina*. Chevallier's genus was also evidently strictly congeneric with Scopoli's. The genus *Friesites* Karsten, "Medd. Soc. Faun. et Fl. Fenn." 5: 41. 1879, and the genus *Dryodon* Quélet; Karsten, "Rev. Myc." 3[1]: 19. 1881, were both established on *Hydnum coralloides* Scop. They are, therefore, typonyms of *Hericium* Pers. and hence metonyms of *Manina* Scop., with which they are apparently also congeneric.

In this connection it is necessary to discuss the proposed names and the status of another so-called genus although it might

[2] Mem. Torrey Bot. Club 12: 112. 1906.

[3] Cf. Persoon, Comment. de Fung. Clavaef. in Holmskiold Coryph. Clav. 155. 1797.

be ignored on technical grounds. In the same work cited above, Adanson published the genus *Martela* based on "*Agaricum* Micheli *pl. 64. f. 1 and 2;* Battara, *pl. 33. f. C;* Corallo fungus Vaillant Botanicon *pl. 8. f. 1.*" This genus, like his *Manina,* was not established according to modern rules. It is, however, important to note that from the citations it included a somewhat heterogeneous collection of forms. The citations from Battarra and Vaillant indicate branched forms of *Clavaria* similar to Adanson's *Manina.* The citation from Micheli is of more interest. The second figure is clearly a form belonging in *Manina* Scop. and is quite typical of the genus. Figure 1 is the form since known as *Hydnum hystricinum* Batsch = *Hydnum Hystrix* (Pers.) Fr. So far as *Martella* Adans. has any type this species must be considered its type. The species both of Batsch and of Fries appears to have been based on Micheli's figure and it appears very doubtful if the form represents a good species. The figure shows a short cylindric stipe terminating above in numerous straight, diverging, erect teeth.

In 1770, Scopoli took up Adanson's name in "Anni historico-naturales" 4: 151 and established it as a genus under the form *Martella*[4] by publishing it with the species *Martella Echinus* Scop. as the type. This latter species differed from Micheli's plant only in being yellow in color and having the teeth or spines fistulose. It is evident, therefore, that *Martella* as conceived both by Adanson and Scopoli stood for forms in which the teeth or spines stood erect, pointing upward and were not pendent as in the case of *Manina* Scop. *Martella* Scop., therefore, is strictly congeneric with *Hericium* Fries as treated in Fries, "Hymenomycetes Europeae" 617.

We must now turn aside to consider the status of the genus *Hericium* Fries. This genus was published by Fries in his "Systema Orbis Vegetabilis," p. 88, in 1825 and he there definitely stated that it was not to be confused with *Hericium* Pers., the type of which he asserted was *Hydnum coralloides.* It seems probable that Fries' conception of *Hericium* Pers. was that of *Manina* Scop. What was his conception of his own *Hericium?*

[4] This appears to be the correct form, as the word is doubtless from the Italian *Martello,* a scourge.

In the work cited he did not publish any species with his genus nor did he form any binomials, but he cited "Hydna Gomphi" from a previous work, "Syst. Myc." 1: 409. 1821. In this latter work the genus *Hydnum* is divided into sections, one of which is designated "Hydna Gomphi" and consists of four species in the following order: *Hydnum Caput-medusae* (Bull.) Pers.; *H. Hystrix* (Pers.) Fr.; *H. Echinus* (Scop.) Fr. and *H. ramarium* Fr. These four species, therefore, constitute the *Hericium* of Fries as published in 1825. It must be noted that according to our code the type of the genus is *Hydnum Caput-medusae*. This species, however, is of somewhat uncertain standing. If a good species, as generally understood, it belongs to the genus *Manina* Scop., and in that case *Hericium* Fr. becomes a metonym of *Manina* Scop. and also of *Hericium* Pers. Yet Fries expressly and emphatically asserts that his genus is distinct from *Hericium* Pers. If now we consider the remaining species of Fries' genus, it appears evident that his own conception of *Hericium* Fr. is that of *Martella* Scop. This is also confirmed by his later treatment of his genus and by his incidental comments. In the "Hymenomycetes Europeae," p. 617, he published his genus *Hericium* with four species which included only two of the original list. These four species were *Hericium Notarisii* (Inz.) Fr.; *H. Echinus* (Scop.) Pers.; *H. Hystrix* (Pers.) Fr.; and *H. alpestre* Pers. and Fries points out that *Hericium* differs from *Hydnum* in that the teeth are not pendent but are erect, pointing upward. In this work *Hydnum Caput-medusae* and *H. ramarium* have been retained in the genus *Hydnum* and are associated with *Hydnum coralloides* Scop. in the tribe *Merisma*, the type of *Hericium* Pers., which Fries expressly stated was not the same as his own *Hericium*. It appears, therefore, that technically *Hericium* Fries is a metonym of *Manina* Scop. The name of course is untenable, being superceded by *Hericium* Pers. As treated in "Hymenomycetes Europeae," *Hericium* Fr. is a synonym of *Martella* Scop.

The species and the genus appear, however, more or less doubtful. *Hydnum hystricinum* Batsch and all its synonyms appear to have been based on Micheli's figure (Nov. Pl. Gen. *pl. 64. f. 1*), and outside of that figure seems to be wholly unknown. *Martella*

Echinus Scop. is evidently known only from Scopoli's original description, "Anni historico-naturales" 4: 151. 1770.[5] The work is little known and we have not seen a copy. So far as later descriptions give one a conception of the plant, it appears that it might be some form of a branching *Clavaria*. *Hydnum Notarisii* Inz. and *H. alpestre* Pers. are the only species of the genus of which authentic specimens are in existence. The specimen of *H. Notarisii* Inz. on which Fries based his description and comments is now preserved in the herbarium at Upsala. It has every appearance of being a form of *Hydnum Erinaceus* Bull. with an unusually long stipe. There appears to be nothing whatever about the specimen to suggest but that it grew with the teeth pendent. The statement "Ob clavam oblique deflexam aculei horizontaliter porrecti" appears to be based on accidental inversion of the plant. Inzenga's type has not been seen unless the Friesian specimen is a part of it. In the herbarium of Persoon at Leyden was found a small piece of a specimen marked "*Hericium alpestre* (Helvetia)." This had every appearance of being a fragment of *H. coralloides* Scop. and we do not believe the Persoonian species is distinct from the latter, at least, it is certainly of the same genus.

From our present knowledge of these forms the most that can be said is that *Martella* Scop. (=*Hericium* Fr. "Hym. Eur." 617) is a genus of very doubtful standing. The genus *Manina* Scop., however, is a well-defined genus that has long been recognized by mycologists under various names.

MANINA Scop. Diss. Sci. Nat. **1**: 97. 1772. Type *Manina cordiformis* Scop.

Hericium Pers. Neues Mag. für die Bot. **1**: 109. 1794. Type, *Hydnum coralloides* Scop.

Hericium Fries, Syst. Orb. Veg. 88. 1825, pro parte. Type, *Hydnum Caput-medusae* (Bull.) Pers.

Medusina Chev. Fl. Gen. des Env. de Paris 278. 1826. Type *Medusina patula* Chev.

[5] Cited from Persoon, Comment. de Fung. Clavaef. 160. Scopoli's work has not been seen. Pritzel gives the number of pages in "Anni historico-naturales" 4 as 150.

Friesites Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 41. 1879. Type, *Hydnum coralloides* Scop.

Dryodon Quél.; Karst. Rev. Myc. 3^1: 19. 1881. Type, *Hydnum coralloides* Scop.

1. MANINA FLAGELLUM Scop. Diss. Sci. Nat. 97. *pl. 11.* 1772

Hydnum laciniatum Leers, Fl. Herb. 276. 1775.

Hydnum ramosum Bull. Hist. de Champ. de la France, 305. *pl. 390.* 1791.

Hydnum abietinum Schrad. Spic. Fl. Germ. 181. 1794.

Medusina coralloides Chev. Fl. Gen. des Env. de Paris, **1**: 279. 1826.

The type specimen of none of the above named species is known to be in existence. The synonymy has, therefore, been determined by a comparison of the original descriptions and figures. Scopoli's figure well represents a form which we have heretofore referred to *H. laciniatum* Leers, but the form is not what we consider as typical of Leers's species, as the branches are too long and slender, yet it does not appear to be specifically distinct.

2. **Manina coralloides** (Scop.)

Hydnum coralloides Scop. Fl. Carn. **2**: 472. 1772.

None of Scopoli's types are in existence so far as known. The species described by him as *H. coralloides* has been long well known and frequently described and figured under his name by other authors, but has been more or less confused with forms which we regard as belonging to the segregation that should be referred to *Manina flagellum* Scop. Scopoli did not include this species in his earlier work, in which he established the genus *Manina,* and in none of his later works did he retain his genus, going back instead to the older genus *Hydnum.* Curiously, therefore, the above combination is now made for the first time nearly one hundred and fifty years after the genus and the species had been described by their common author.

3. **Manina Caput-ursi** (Fries)

Hydnum Caput-ursi Fries, Monog. Hym. Suec. **2**: 278. 1863.

No specimen whatever under the above name was found in the herbarium of Fries at Upsala, nor does the species appear to be well represented in any of the European herbaria. So far as can be judged from such poor fragmentary material as the herbaria furnish no well-defined distinction exists between *Hydnum Caput-ursi* Fr. and *H. Caput-medusae* (Bull.) Pers.

4. MANINA CORDIFORMIS Scop. Diss. Sci. Nat. 97. *pl. 10.* 1772.

Hydnum Erinaceus Bull. Hist. de Champ. de la France, 304. *pl. 34.* 1791.
Hericium grandis Raf. Prec. des Decouv. Somiol. 50. 1814.
Steccherinum quercinum S. F. Gray, Nat. Arr. Brit. Pl. **1**: 651. 1821.
Medusina patula Chev. Fl. Gen. des Env. de Paris, **1**: 279. 1826.

Type specimens of none of the forms described under the above names are known to exist. The species, however, is a striking and well-known form that often attracts attention, and there seems to be no reason to question the correctness of the synonymy. The species has generally been known under the name of Bulliard. Scopoli's figure *loc. cit.* shows most clearly that his *M. cordiformis* is the typical form that is everywhere referred to *H. Erinaceus* Bull. The law of priority, therefore, demands that his names should prevail and we have restored it to the species.

5. **Manina Schiedermayeri** (Heufl.)

Hydnum Schiedermayeri Heufler, Osterr. Bot. Zeitschrift **20**: 33. 1870.

The type specimen of this species has not been seen and our conception of the characters is based upon American plants which we have referred here from comparison with the published descriptions and figures. To judge from these American forms, the species departs widely from the generic type and would appear to belong to the resupinate-effused type of structure. Fries, however, regarded the species as of this alliance and the conspicuous

tubercles with pendent teeth, together with the spore characters, suggest at least a close affiliation with the genus *Manina.* We have previously referred this species to "*Hydnum croceum* Schw." On a recent re-examination of Schweinitz's herbarium we have had the good fortune to discover his specimens under this name and it appears very evident that they are not distinct from his *Phlebia hydnoides.* We have, therefore, restored the name of Heufler to this species.

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ASPERGILLUS INFECTING MALACOSOMA AT HIGH TEMPERATURES

Wilson P. Gee and A. Ballard Massey

In some experiments on the relation of temperature to the life-cycle of the apple tent-caterpillar (*Malacosoma americana* Fabr.), a serious difficulty presented itself in the mortality among the specimens at the higher temperatures due to the infection of the caterpillars with the fungus *Aspergillus flavescens* Eidam. With regard to the injurious nature of the fungi of the genus *Aspergillus,* DeBary[1] has the following to say: "A number of species of *Aspergillus,* all of which occur chiefly as saprophytes and in that mode of life reach their full development, in some cases even forming sporocarps, are able to migrate to the bodies of warm-blooded animals and live at their expense. Their vegetation causes or promotes a diseased state of the parts known to physicians as *mycosis. A. flavus, A. niger,* and *A. fumigatus, Eurodium repens,* and *Aspergillus glaucus* are characteristic promoters of the disease of the human ear which bears the name of *Otomycosis aspergillina.*" In regard to the specific fungus with which we are dealing, he states that "Gaffky and others, Lichtheim especially, obtained characteristic phenomena of development, in this case phenomena of disease, when the gonidia of *Aspergillus fumigatus* and *A. flavescens* Eidam, two species distinguished by the high optimum of their vegetative temperature, over 37° C., were introduced by injection into the blood of animals, such as rabbits and dogs."

In the above mentioned experiments, the larvae were subjected continuously to a temperature of 35°–37° C., and were thus at the optimum developmental condition of *A. flavescens.* Although careful search was made in several nests of *Malacosoma americana,* only two specimens which showed any infection whatever from this fungus were secured, among many hundreds, and

[1] Comp. Morph. and Biology of the Fungi, Mycetozoa and Bacteria, 369, 370. 1887.

these were in a nest which had been previously sprayed with a suspension of spores in sterile water. Thus the fungus cannot be classed as of economic importance since it is only at the higher temperatures that it does its damage.

These conditions suggested a series of experiments to try out the possibility of artificial infection at the normal and higher temperatures.

Six larvae from a perfectly normal nest together with a sufficient number of wild cherry leaves for food, were put into each of four sterile bottles, two of which were sprayed with a spore suspension and the other two kept as a check. The bottles were

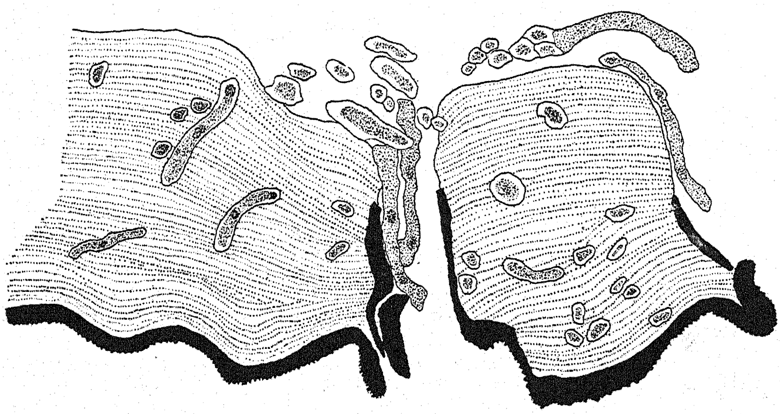

FIG. 1. Section through the cuticle of *Malacosoma americana* Fabr. showing the penetration of *Aspergillus flavescens* Eidam to the exterior through the region of a dermal pore, and the presence of the fungus in the inner layer of the chitin. × 400.

plugged with sterile cotton and placed in the same compartment of an incubator maintained at a temperature of about 37° C. A similar experiment was conducted at the normal outdoor temperature (21°–27° C.). At the end of three days all of the larvae in the sprayed bottle kept in the incubator were dead from infection with *Aspergillus flavescens*. The control specimens, at the incubator temperature, showed no signs of such infection. In the case of the experiment conducted at outdoor temperature, none of the larvae, either sprayed or unsprayed, showed any signs of such infection. A second series of these experiments was carried on with the same results as the first.

Daily observation of the larvae infected showed that the fungus first appeared at the posterior fourth of the body, and from this region progressed anteriorly. This seemed to indicate that infection takes place from the germination of spores taken into the digestive tract of the caterpillar along with its food. Favorable conditions for germination were found in the region of the hind intestine of the insect and the mycelia produced found their way through the intestinal wall into the body cavity and penetrated the chitinous covering in the region of the dermal pores to the exterior of the body. Sections of the larva substantiated this conclusion, and an examination of the accompanying figure will show the presence of mycelia and spores in the inner layer of the chitin covering the body cavity.

The entire body cavity was found to be filled with mycelia and multitudes of spores, accompanied by an almost complete disintegration of cellular structures. This cytolytic action, coupled with interference with the respiratory processes of the insect, affords sufficient cause for its death.

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TWO NEW SPECIES OF RUSTS

William H. Long

On a collecting trip at Takoma Park, Maryland, with Dr. G. G. Hedgcock, a caeoma-like species of *Peridermium* was collected on *Pinus rigida* Mill. which proved to be *Peridermium delicatulum* Arth. & Kern. Later, in looking over the species of *Peridermium* in the Pathological Collections of the United States Department of Agriculture, hoping to find other collections of this rare species, the writer found a specimen on *Pinus virginiana* Mill., which from its gross characters appeared to be *Peridermium delicatulum,* but a microscopic examination showed it to be an undescribed species.

On a trip made during 1911 through some of the forests of Arizona and new Mexico, the writer while descending the Santa Catalina Mountains found, on *Coursetia glandulosa* Gray, a rust which on microscopic examination proved to be an undescribed species intermediate in its generic position between *Phragmopyxis* Dietel and *Calliospora* Arth. Technical descriptions of these two fungi are given below.

Tricella gen. nov.

Cycle of development includes only pycnia and telia, the former subcuticular, the latter subepidermal. Pycnia conoidal, ostiolar filaments usually present; telia erumpent, without paraphyses; teliospores free, three-celled by transverse septa; walls laminate, the inner layer firm, colored, the outer layer gelatinous, translucent, overlaid by cuticle, the pores 3 or 4 in each cell and lateral, pedicel bulbous in the middle.

This genus is intermediate in its characters between *Phragmopyxis* and *Calliospora,* having the three-celled teliospores of the former, and the same cycle of development as the latter.

Tricella acuminata sp. nov.

O. Pycnia epiphyllous in groups intermixed with the telia, smooth, pale-brown, subcuticular, 70–75 μ wide by 50–70 μ high; ostiolar filaments hyaline, 25–35 μ long.

III. Telia amphigenous but mainly epiphyllous, those on lower surface usually opposite corresponding telia on upper surface, more or less circular to ellipsoid, often confluent, 0.5 to 4 mm. in diameter, blackish-brown, pulverulent, ruptured epidermis rather inconspicuous; teliospores ellipsoid to ellipsoid-ovoid, acuminate, rounded at base, 25–40 × 50–75 μ, not constricted at septa; walls laminate, the inner layer firm, dark-brown, 3–4 μ thick, the pores 3 or 4 in each cell, lateral and opposite, the outer layer gelatinous, pale amber-colored at apex, remainder of layer colorless, 4–7 μ thick, sparsely and evenly verrucose; pedicel 50–100 μ long, 10–12 μ thick near spore, colorless, except part at base which is amber-colored for about 10 μ where it broadens out into an ovoid to ellipsoid, hyaline, solid bulb 20–30 μ wide by 25–40 μ long, then contracts into normal size and shape, pedicel down to and including bulb solid or nearly so, below bulb hollow but with thick walls, outer layers of bulb rapidly swelling in water and bursting. Spores often deciduous just below bulb even before being wet; portion of pedicel below bulb not gelatinous nor swelling in water.

On FABACEAE. Type collected on *Coursetia glandulosa* Gray in Sabina Canyon, 5000–7000 feet elevation, Santa Catalina Mountains, Arizona, October 15, 1911, by Long & Hedgcock. It was first found at an elevation of about 7000 feet and was fairly common on this host along the south trail down to the foot of the mountain in the canyon. The writer is indebted to Prof. J. J. Thornber for the identification of the host.

Peridermium inconspicuum sp. nov.

O. Pycnia chiefly hypophyllous, sparse in material at hand, low, conoidal, subcorticular, dehiscent by a longitudinal slit, 0.2–0.3 mm. broad, 0.3–0.7 mm. long, 85–120 μ high.

I. Aecia from a limited mycelium, amphigenous, one to several on slightly discolored spots occupying part of leaf, erumpent from a narrow slit, flattened laterally, 0.3–0.7 mm. long by 0.3–0.9 mm. high, rupturing irregularly, peridium colorless, very fragile, cells overlapping, oblong-lanceolate to oblong, 19–26 μ wide by 32–55 μ long, average size for ten cells 20 × 37 μ, outer wall about 3 μ thick, minutely verrucose, inner wall 5–8 μ thick, closely verrucose, with rather prominent papillae. Aeciospores ellipsoid to spheroid 16–18 × 22–30 μ, average size for ten spores 16.7 × 25 μ, walls colorless, thin, 1–2 μ, minutely verrucose, warts often in irregular groups with clear areas between.

On PINACEAE. Type collected on *Pinus virginiana* Mill. at Glen Echo, Maryland, May 5, 1907, by Miss V. K. Charles. Also collected in same locality on same host June 16, 1912. This species is intermediate in its characters between *Peridermium delicatulum* Arth. & Kern and *Peridermium montanum* Arth. & Kern, but differs from the former in its more prominent aecia and in its overlapping and oblong-lanceolate peridial cells and from the latter in the size of the peridial cells and in the shape and size of the aeciospores.

The peridia of this species are very fragile, so much so that the herbarium specimens collected in 1907 have entirely lost their peridia, and in the field they soon fall away, making the aecia inconspicuous. In this condition they much resemble *Peridermium delicatulum* but a microscopic examination readily shows that the peridial cells distinctly overlap and are not isodiametric but are much longer than broad. This seems to be the first foliicolous species of *Peridermium* reported for this host. The type material was collected from a tree about four feet tall, and was fairly abundant on this one plant. This season (1912) a careful search was made over the same locality from which the type was collected, but only five affected needles were found, and then only one or two to a tree.

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INDEX TO AMERICAN MYCOLOGICAL LITERATURE

This index is prepared by Dr. B. O. Dodge, of Columbia University, and covers the same scope for the fungi as that covered by the general index published monthly in the Bulletin of the Torrey Botanical Club. It is not reprinted on cards for distribution.

Broadhurst, J. A biometrical study of milk streptococci. Jour. Infect. Dis. **10**: 272–284. My 1912.

Brown, P. E. Some bacteriological effects of liming. Centralb. Bakt. Zweite Abt. **34**: 148–172. 15 My 1912.

Chivers, A. H. Preliminary diagnoses of new species of *Chaetomium*. Proc. Am. Acad. Sci. **48**: 83–88. Jl 1912.

Nine new species are described.

Claassen, E. Alphabetical list of lichens collected in several counties of northern Ohio. Ohio Nat. **12**: 543–548. 7 Je 1912.

One hundred and twenty-eight species listed.

Dodge, B. O. Artificial cultures of *Ascobolus* and *Aleuria*. Mycologia **4**: 218–222. *pl. 72, 73*. 13 Jl 1912.

Ascobolus magnificus described as new.

Dutton, D. L. Lichen flora of Vermont. Bull. Vermont Bot. Club **7**: 23–25. My 1912.

Faull, J. H. The cytology of *Laboulbenia chaetophora* and *L. Gyrinidarum*. Ann. Bot. **26**: 325–355. *pl. 37–40*. Ap 1912.

Fawcett, H. S. The cause of stem-rot of citrus fruits (*Phomopsis citri* n. sp.). Phytopathology **2**: 109–113. *pl. 8, 9*. Je 1912.

Fraser, W. P. Cultures of heteroecious rusts. Mycologia **4**: 175–193. 13 Jl 1912.

The following life histories are worked out for the first time: *Necium Farlowii* Arth., *Pucciniastrum minimum* (Schw.) Arth., *Melampsoropsis Pyrolae* (DC.) Arth., *Uromyces Spartinae* Farl., *Melampsora arctica* Rostr., and *M.* (*Medusae* Thum.?).

Giddings, N. J. A practical and reliable apparatus for culture work at low temperatures. Phytopathology **2**: 106–108. *pl. 7*. Je 1912.

Gloyer, W. O. Apple blister canker and methods of treatment. Ohio Agr. Exp. Sta. Circ. **125**: 149–161. 20 My 1912.

Graves, A. H. The large leaf spot of chestnut and oak. Mycologia **4**: 170–174. *pl. 69* + *f. 1*. 13 Jl 1912.

The leaf spot is caused by *Monochaetia Desmazierii* Sacc.

Griffon, E, & Maublanc, A. Les *Microsphaera* des chênes. Bull. Soc. Myc. France **28**: 88–104. *pl. 3–5*. 15 Ap 1912.

Discusses American species found.

Harter, L. L., & Field, E. *Diaporthe,* the ascogenous form of sweet potato dry rot. Phytopathology **2**: 121–124. *f. 1–4*. Je 1912.

Includes *Diaporthe batatatis* sp. nov.

Hewitt, J. L. Rice blight. Arkansas Agr. Exp. Sta. Bull. **110**: 447–459. 1912.

Hill, A. W. A visit to the West Indies. Kew Bull. Misc. Inf. **1912**: 166–189. My 1912.

Contains some information relating to the fungi and other plants of these islands.

Howard, B. J. Decomposition and its microscopical detection in some food products. Yearbook Dept. Agr. **1911**: 297–308. *pl. 15–19*. 1912.

Contains information relating to certain molds and bacteria.

Massee, G. Fungi exotici: XIII. Kew Bull. Misc. Inf. **1912**: 189–191. My 1912.

Includes *Eutypa gigaspora* Massee from Trinidad.

McMurran, S. M. A new internal *Sterigmatocystis* rot of pomegranates. Phytopathology **2**: 125, 126. Je 1912.

Murrill, W. A. The *Agaricaceae* of the Pacific Coast—I. Mycologia **4**: 205–217. 13 Jl 1912.

Includes 13 new species, in *Hydrocybe* (3), *Hygrophorus* (3), *Armillaria* (1), *Limacella* (2), *Geopetalum* (3), and *Crepidopus* (1).

Murrill, W. A. Illustrations of fungi—XI. Mycologia **4**: 163–169. *pl. 68*. 13 Jl 1912.

Suillellus luridus (Schaeff.) Murrill, *Collybidium dryophilum* (Bull.) Murrill, *Flammula carbonaria* (Fries) Quél., *Anthurus borealis* Burt., *Mycena vexans* (Peck) Sacc., *Omphalopsis Campanella* (Batsch) Earle, *Naucoria subvelosa, Mycena praedecurrens, Russula stricta,* and *Marasmius magnisporus* spp. nov. are illustrated and described.

Orton, C. R. Correlation between certain species of *Puccinia* and *Uromyces*. Mycologia **4**: 194–204. *pl. 70, 71*. 13 Jl 1912.

Includes *Puccinia uniporula* sp. nov.

Phillips, F. J., & Mulford, W. Utah juniper in central Arizona. U. S. Forest Serv. Circ. **197**: 3–19. *pl. 1, 2 + f. 1.* 8 Je 1912.

Includes notes on injuries to the trees by *Pyropolyporus texanus, Gymnosporangium gracilens,* and *G. nelsoni.*

Reed, H. S., Cooley, J. S., & Rogers, J. T. Foliage diseases of the apple. Virginia Polytech. Inst. Agr. Exp. Sta. Bull. **195**: 3–23. *f. 1–13.* F 1912.

Saccardo, P. A. Notae mycologicae, Series XIV. Ann. Myc. **10**: 310–322. 10 Je 1912.

"1. Fungi ex Gallia, Abyssinia, Japonia, Mexico, Canada, Amer. bor. et. Centr."

Includes fifteen new species of fungi from America.

Sackett, W. G. Bakteriologische Untersuchungen über die Stickstoffbindung in gewissen Bodenarten von Colorado. Centralb. Bakt. Zweite Abt. **34**: 81–115. *f. 1–5.* 15 My 1912.

Smith, E. F., Brown, N. A., & McCulloch, L. The structure and development of crown gall: a plant cancer. U. S. Dept. Agr. Plant Ind. Bull. **255**: 11–60. *pl. 1–109 + f. 1, 2.* 29 Je 1912.

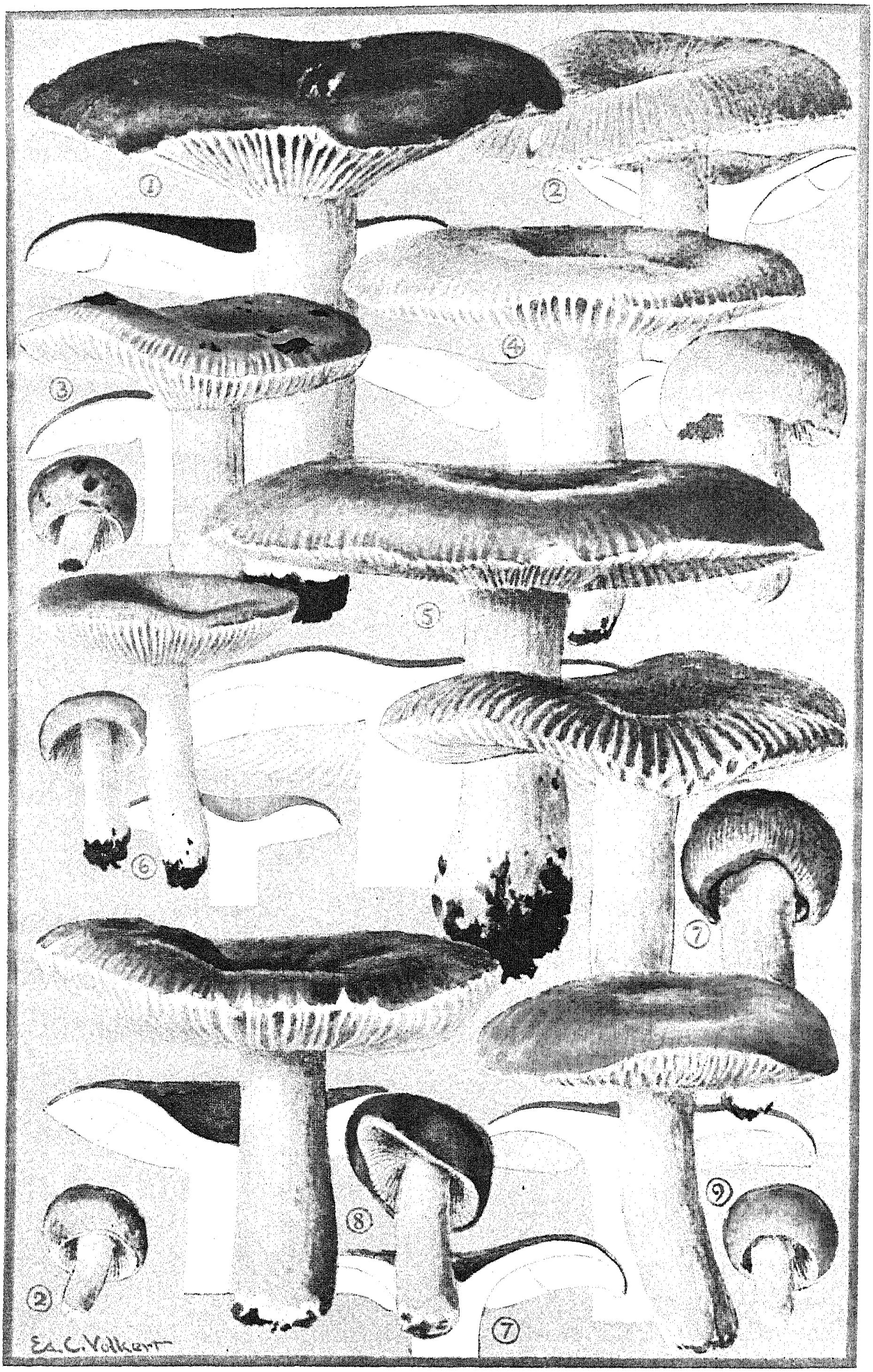
Stevens, N. E. Wood rots of the hardy catalpa. Phytopathology **2**: 114–119. *pl. 10.* Je 1912.

Stewart, R., & Greaves, J. E. The production and movement of nitric nitrogen in soil. Centralb. Bakt. Zweite Abt. **34**: 115–147. *f. 1.* 15 My 1912.

Taubenhaus, J. J. Present knowledge of sweet pea diseases and their control. Florists' Exchange **34**: 108–110. 20 Jl 1912. [Illust.]

Theissen, F. Die Gattung *Clypeolella* v. Höhn. Centralb. Bakt. Zweite Abt. **34**: 229–235. 22 Je 1912.

Includes *Clypeolella Ricini* Rac., *C. Solani* Theiss., and *C. apus* Theiss. spp. nov.



ILLUSTRATIONS OF FUNGI

MYCOLOGIA

VOL. IV NOVEMBER, 1912 No. 6

ILLUSTRATIONS OF FUNGI—XII

WILLIAM A. MURRILL

The figures on the accompanying plate[1] were all drawn from specimens collected in and near Bronx Park, New York City, and represent a few of the many attractive and highly-colored species included in the genus *Russula*. This very difficult genus is now being monographed for NORTH AMERICAN FLORA by Dr. Gertrude S. Burlingham, who has kindly determined for me the species here figured.

Most of the members of this genus are edible, and some of them are particularly good, but they are usually scattered, are fragile and perishable, become infested early with a variety of insects, are eaten by squirrels and other animals, and resemble one another so closely that it is advisable to go to the trouble of tasting nearly every specimen before selecting it for the table. There are no violently poisonous species known in this genus, and if specimens have a mild taste and an agreeable odor they are probably harmless, but it must always be remembered that it is necessary to test each new species thoroughly before using it in any quantity for food. The botanical characters of the genus are not difficult to learn, and it may be distinguished from the nearest related genus, *Lactaria,* by the absence of a milky juice in the tissues of the sporophore.

[MYCOLOGIA for September, 1912 (4: 231–287), was issued August 28, 1912]

[1] This plate should be numbered 76 instead of 74.

Russula sericeonitens Kauffman

SILKY-SHINING RUSSULA

Plate 76. Figure 1. × 1

Pileus regular, convex to plane or depressed, gregarious, reaching 9 cm. broad; surface smooth, rather viscid, dark-purple, blackish-purple at the center, not striate on the margin; context rather thick, white, mild to the taste, odor not characteristic; lamellae white, becoming slightly yellowish with age but not ochraceous; spores subglobose, roughly tuberculate, hyaline, 8–10 μ; stipe cylindric, equal, smooth, dry, milk-white, 5–7 cm. long, scarcely 2 cm. thick.

Collected on the ground in oak woods near Bronx Park, New York City, September 10, 1910, by W. A. Murrill. Described in 1909 from northern Michigan, where it is not uncommon in mixed woods during July and August, usually growing solitary. The spores of the typical plant are recorded as 6–7.5 μ.

Russula Mariae Peck

MARY'S RUSSULA

Plate 76. Figures 2 and 8. × 1

Pileus fleshy, convex and subumbilicate to depressed, reaching 7 cm. broad; surface dry, rose-red or purple with darker disk, having a bloom like a peach, margin slightly striate at times, especially in old plants; context thin, of good flavor, white, pinkish under the cuticle, odor not characteristic; lamellae white or stramineous, broad, subcrowded, interveined; spores subglobose, minutely conic-tuberculate, yellow, 7 μ; stipe equal, solid, rosy, sometimes partly white, glabrous, about 1.3–1.5 cm. thick.

Common under oaks throughout the eastern United States. Figure 8 represents the more usual form; figure 2 shows a variety having lilac or violet tints with a beautiful white bloom or pruinosity. This is one of our prettiest species, as well as one of the best for the table.

Russula emetica Fries

EMETIC RUSSULA

Plate 76. Figure 3. × 1

Pileus regular, firm to fragile, convex to plane or depressed, 5–8 cm. broad; surface viscid when young, polished, red, often

fading to pallid or yellowish, cuticle separating very readily; context white, reddish under the cuticle, very acrid to the taste; lamellae white, then dull-yellowish, free, subdistant, broad, equal; spores globose, echinulate, hyaline, 8–10 μ; stipe rosy or whitish, glabrous, spongy-solid, 3–7 cm. long, 1–1.5 cm. thick.

Common in woods throughout Europe and the eastern United States, often growing where logs have decayed. Distinguished by its red color, viscid surface, readily separating cuticle, and very acrid taste. In addition to its acrid quality, it is definitely poisonous, containing small quantities of choline, pilzatropine, and probably muscarine. When taken in any quality, it acts as a prompt emetic. It is mainly because of this species that most specimens of *Russula* should be tasted before selecting them for food.

Russula sulcatipes sp. nov.

FURROWED-STEMMED RUSSULA

Plate 76. Figure 4. × 1

Pileus convex to plane or depressed, reaching 7 cm. broad; surface dry, pruinose, smooth, pale avellaneous-isabelline, slightly striate on the margin, becoming more conspicuously so on drying; context very thin, white, very firm, mild and nutty to the taste, odor not characteristic; lamellae white, becoming cream-colored or somewhat darker on drying, adnate, plane, subdistant; spores globose, roughly tuberculate, hyaline under a microscope, 7–9 μ; stipe equal or slightly enlarged below, with rather conspicuous longitudinal raised lines, milk-white, glabrous, solid, about 5 cm. long and 1.3 cm. thick.

Type collected on the ground in oak woods near Bronx Park, New York City, September 10, 1910, by W. A. Murrill.

Russula obscura Romell

OBSCURE RUSSULA

Plate 76. Figure 5. × 1

Pileus convex to expanded or depressed, reaching 12 cm. broad; surface slightly viscid, vinosous at the center, much paler vinosous toward the margin, slightly striate on the immediate margin, usually decorated with bits of earth and leaves that are carried upward as the sporophore emerges from the soil; context white, at first mild, at length somewhat peppery; lamellae white or

straw-yellow when viewed perpendicularly, becoming somewhat cinereous or discolored on drying; spores subglobose, roughly tuberculate, hyaline, 8 μ; stipe white with a cinereous tint, smooth, ochraceous, solid, 6 × 2–2.5 cm.

Collected on a rather dry bank at the edge of oak woods near Bronx Park, New York City, May 22, 1910, by W. A. Murrill. Described from Sweden.

Russula uncialis Peck

INCH RUSSULA

Plate 76. Figure 6. × 1

Pileus thin, very fragile, convex to plane or depressed, 2.5–4.5 cm. broad; surface dry or slightly viscid, glabrous or minutely granulose, at times obscurely striate on the margin, red or rosy with incarnate or testaceous hues; context thin, white, of mild flavor, without odor; lamelae white, becoming stramineous or cremeous, interveined, subcrowded, narrow behind; spores globose, rough, hyaline, 7–8 μ; stipe equal or enlarging below, glabrous, spongy or stuffed, milk-white, rarely reddish, 2.5–4 cm. long, 4–10 mm. thick.

Collected under an oak on the grounds of the New York Botanical Garden. Found sparingly in certain localities in the eastern United States.

Russula foetens Pers.

FETID RUSSULA

Plate 76. Figure 7. × 1

Pileus firm, rather thin, globose to plane or slightly depressed, 5–10 cm. broad; surface very viscid, slimy, conspicuously striate-tuberculate, ochraceous-melleous, testaceous-fulvous in the center with small bay or blackish areas; context whitish, tardily acrid and mucilaginous to the taste, with odor of prussic acid; lamellae mostly equal, adnate or adnexed, subcrowded, arcuate, white, staining brownish when injured, usually decorated with small drops of water when the air is damp; spores globose, strongly echinulate, hyaline, 10 μ; stipe cylindric, equal or somewhat ventricose, glabrous or subglabrous, white, staining brownish when injured, hollow, 5–8 cm. long, 1–2 cm. thick.

This conspicuous species is common under oaks in groves or

woodlands throughout most of Europe and the United States, sometimes occurring in great quantity in one spot. Its odor is similar to that of peach kernels, and in some specimens it is strong and unpleasant, although at times it may be scarcely noticeable. This unpleasant odor and the very slimy character of the surface render the plant unattractive and one would hardly collect it for food. It is known to be definitely poisonous to a certain extent and should always be avoided by mycophagists.

Russula rubriochracea sp. nov.

RED AND YELLOW RUSSULA

Plate 76. Figure 9. × 1

Pileus convex to plane or slightly depressed, reaching 6 cm. broad; surface red or purple with a bloom, darker in the center, not at all striate, dry, smooth, margin entire, concolorous; context white, thin, taste at first nutty, becoming distinctly but not violently acrid, odor not characteristic; lamellae exactly ochraceous even in a very young stage, adnexed, plane, subdistant; spores subglobose, roughly tuberculate, hyaline under a microscope, ochraceous in mass, 8–11 μ; stipe tapering below, smooth, dry, glabrous, pale rose-colored or lilac, about 4.5 cm. long and 1.3 cm. thick.

Type collected on the ground in oak wooks near Bronx Park, New York City, September 10, 1910, by W. A. Murrill. Related to *R. Mariae,* but estriate, acrid, and with yellow lamellae.

NEW YORK BOTANICAL GARDEN.

THE AGARICACEAE OF THE PACIFIC COAST—III

William A. Murrill

(With Plate 77, Containing 2 Figures)

The species here treated have brown or black spores. Some of them are celebrated for their edible qualities. No dangerously poisonous species are known to belong to this group, although many of them have not been tested.

Spores brown.	
Annulus present.	
Lamellae free.	1. Agaricus.
Lamellae adnate.	2. Stropharia.
Annulus absent; veil appendiculate.	
Scattered or subcespitose, rarely densely cespitose; surface hygrophanous, viscid, or squamulose.	3. Drosophila.
Densely cespitose; surface firm, dry, glabrous.	4. Hypholoma.
Spores black or olivaceous.	5. Gomphidius.

1. Agaricus (Dill.) L. Sp. Pl. 1171. 1753

1. Agaricus campestris L. Sp. Pl. 1173. 1753

Seattle, Washington, *Zeller 109;* Golden Gate Park, California, *Murrill 1114;* La Honda, California, *Murrill & Abrams 1251, 1277;* Stanford University, California, *Nohara 2, Miss Patterson 17, Baker 130;* California, *Harper;* Kadiak, Alaska, *Trelease 504*.

2. Agaricus californicus Peck, Bull. Torrey Club **22**: 203. 1895

Pileus at first subconic, becoming convex, minutely silky or fibrillose, whitish, tinged with purple or brownish-purple on the disk; flesh whitish; lamellae close, free, pink becoming purplish, then blackish-brown; stem rather long, solid or stuffed, equal or tapering upward, distinctly and rather abruptly narrowed above the entire, externally silky annulus, pallid or brownish; spores broadly ellipsoid, $5–6 \times 4–5\ \mu$.

Pileus 2.5–7.5 cm. broad; stem 4–7.5 cm. long, 4–8 mm. thick. Type collected by McClatchie under oak trees near Pasadena, California. Said by the author to resemble *A. haemorrhoidarius* in size, shape, and habitat, but to differ in color and surface adornment. According to Baker, it is abundant and much collected for food in pastures and lawns about Stanford University.

Pasadena, California, *McClatchie;* Stanford University, California, *Baker 123, Dudley 179, Nohara 39;* Searsville, California, *W. G. Johnston.*

3. AGARICUS HAEMORRHOIDARIUS Fries, Hymen. Eur. 281. 1872

Berkeley Camp, California, *Harper.* The specimens were determined as above by Professor Harper when collected. They also agree with plants at Albany so determined by Dr. Peck.

4. AGARICUS SILVICOLA Sacc. Syll. Fung. **5**: 998. 1887

Agaricus campestris silvicola Vitt. Fung. Mang. 43. 1835.
Agaricus bulbosus McClatchie, Proc. S. Cal. Acad. Sci. **1**: 382. 1897.

This species was found commonly in woods. The spores are rather small, measuring $5 \times 3.5\,\mu$.

Seattle, Washington, *Murrill 231, 281, 478, 581, Zeller 106;* Stanford University, California, *McMurphy 133, Miss Patterson 3, 33.*

5. AGARICUS PLACOMYCES Peck, Ann. Rep. N. Y. State Mus. **29**: 40. 1878

Seattle, Washington, *Murrill 285, 524;* Muir Woods, California, *Murrill 1130.* The specimen from Muir Woods was avellaneous-umbrinous at the center, becoming blackish on drying, and the stipe below the annulus was prominently marked with close, concentric, irregular ridges.

6. AGARICUS SILVATICUS Schaeff. Fung. Bav. 62. 1800

Tacoma, Washington, *Murrill 722:* surface densely covered with large reddish-brown scales; spores ellipsoid, $6 \times 3.5\,\mu$.

Searsville Lake, California, *McMurphy 115:* scales more broken into fibrils and color somewhat darker, but otherwise like the Washington plants.

7. AGARICUS PATTERSONAE Peck, Bull. Torrey Club **34**: 347. 1907

Pileus fleshy, firm, convex or nearly plane, glabrous or minutely silky, white or whitish, often mottled with brownish squamules; flesh firm, white, taste fungoid; lamellae close, free, pink, becoming blackish-brown or black with age; stem equal or slightly tapering upward, firm, stuffed, bulbous, white or whitish, the annulus white, often rupturing and partly adhering to the margin of the pileus; spores broadly ellipsoid, 8–9 μ long, 5–6 μ broad.

Pileus 6–14 cm. broad; stem 7–12 cm. long, 2–3 cm. thick.

Described from specimens collected by Miss Patterson under pine and cypress trees at Stanford University, California. The types at Albany are in poor condition, but the photograph accompanying them shows imbricated fibrils and scales over the surface similar to those of the dark form of *A. campestris,* to which it seems closely related.

Stanford University, California, *Miss Patterson 18.*

8. **Agaricus hondensis** sp. nov.

Pileus convex to plane or somewhat depressed, solitary, 7 cm. broad; surface dry, smooth, glabrous, white to slightly purplish-black, the center concolorous; lamellae free, crowded, ventricose, at length fuliginous; spores ellipsoid, smooth, pale purplish-brown under a microscope, $5 \times 2.5\,\mu$; stipe somewhat fusiform with a small bulb, dry, smooth, glabrous, white, 9 cm. long, 1 cm. thick at the center; annulus ample, simple, persistent, fixed, superior.

Type collected in sandy loam under redwoods at La Honda, California, November 25, 1911, *W. A. Murrill & L. R. Abrams 1260.*

9. AGARICUS BIVELATUS Peck, Bull. Torrey Club **36**: 335. 1909

Pileus fleshy, thin, broadly convex, radiately fibrillose and floccose, cream-colored slightly tinged with pink, smoky-brown in the center; lamellae thin, close, free, pink then seal-brown; stem

equal or slightly bulbous, glabrous, shining, white-floccose at the top, stuffed or hollow, cream-colored, with a narrow double annulus which at length disappears; spores subglobose, 5–6 $\mu \times$ 4–5 μ.

Pileus 4–5 cm. broad; stem 3.5–6 cm. long, 8–11 mm. thick.

Described from specimens collected by Baker under oaks at Claremont, California.

10. AGARICUS SUBNITENS Peck, Bull. Torrey Club 36: 335. 1909

Pileus fleshy, broadly convex or slightly depressed in the center, densely fibrillose, shining on the margin, cream- or tan-colored; flesh white; lamellae thin, close, free, pink becoming dark-brown; stem equal or slightly thickened below, stuffed or hollow, white and fibrillose above, cream-colored and shining below with a finally deciduous brown but white-margined annulus; spores ellipsoid, purplish-brown, 6–8 $\mu \times$ 4–5 μ.

Pileus 4.5–9.5 cm. broad; stem 8.5–13 cm. long, 1–1.5 cm. thick.

Described from specimens collected by Baker under oaks at Claremont, California. Apparently not sufficiently distinct from *A. bivelatus*.

11. **Agaricus bivelatoides** sp nov.

Pileus truncate-conic to convex with a large umbo, not fully expanding, drying thin, 4 cm. broad; surface minutely imbricate-fibrillose, dry, uniformily pale-avellaneous throughout; lamellae free, crowded, ventricose, becoming fuliginous; spores ellipsoid, smooth, purplish-brown, 5 $\times$ 2.5 μ; stipe enlarging below, with very small bulb, subconcolorous, minutely fibrillose, 6 cm. long, 4–6 mm. thick; annulus superior, simple, fixed, persistent, white.

Type collected on the ground under redwoods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 493*. Related to *A. bivelatus* Peck.

12. **Agaricus comptuloides** sp. nov.

Pileus small, thin, conic to convex, umbonate, solitary, 3 cm. broad; surface rosy-isabelline to whitish, pinkish-brown to fulvous on the umbo, dry, slightly fibrillose-scaly, margin entire, concolorous; lamellae free, crowded, plane, becoming fuliginous; spores ellipsoid, smooth, pale-purplish under a microscope, 5 $\times$ 2.5 μ; stipe smooth, polished, enlarged and white below, pinkish

above, becoming yellowish throughout on drying, 7 cm. long, 4 mm. thick above, 8 mm. thick below; annulus white to yellow, membranous, ample, persistent, fixed just above the middle of the stipe.

Collected in humus on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 434* (*type*), *523*. Related to *A. comptulus* Fries and *A. diminutivus* Peck.

13. **Agaricus flavitingens** sp. nov.

Pileus hemispheric to broadly convex, not umbonate, drying thin, gregarious, 6 cm. broad; surface dry, smooth, imbricate-fibrillose-scaly, fulvous with a latericeous tint at the center, fading out to stramineous toward the margin; lamellae free, ventricose, not crowded, avellaneous to umbrinous; spores ovoid, smooth, purplish-brown, $4–5 \times 3–4\,\mu$; stipe cylindric, slightly larger at the base, smooth, glabrous, white above the annulus, ochraceous-tinted below, 5 cm. long, 1 cm. thick; annulus ample, membranous, persistent, fixed about the center of the stipe, white, changing to yellow on drying.

Type collected in sandy soil in fir woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 381*.

14. **Agaricus Hillii** sp. nov.

Pileus regular, convex, thick and fleshy, solitary, 5–10 cm. broad; surface smooth, dry, subglabrous, white, slightly grayish-brown at the center, becoming pale-bay at the center on drying, margin thin, entire, decorated with fragments of the veil; context white to slightly pinkish, not changing, with pleasant taste and odor; lamellae free, crowded, broad, ventricose, pink to fuliginous; spores ellipsoid, smooth, purplish-brown under a microscope, $5–6 \times 3.5\,\mu$; stipe bulbous, tapering upward, smooth, glabrous, white, pinkish above the annulus, stuffed or hollow, 7–10 cm. long, 8–12 mm. thick; annulus superior, simple, white, large, persistent.

Type collected among moss and humus in open woods on Mayne Island, Gulf of Georgia, British Columbia, December 12, 1904, *Albert I. Hill 104*.

15. **Agaricus Abramsii** sp. nov.

Pileus irregular, owing to the position of the plant, thick, fleshy, plane, solitary, 6 cm. broad; surface dry, finely imbricate-

scaly, whitish with a rosy tint; lamellae free, crowded, narrow, plane, pallid; spores ovoid, smooth, hyaline to pale-umbrinous under a microscope, 6–7 × 3.5–4 μ; stipe eccentric, fusiform, white, polished, hollow, 6 × 2 cm.; annulus near the base, white, not conspicuous.

Type collected on a clay bank by the roadside at 800 ft. elevation on the Santa Cruz Mountains near Palo Alto, California, November 25, 1911, *W. A. Murrill & L. R. Abrams 1227*. Distorted, owing to its position on the side of the bank.

16. **Agaricus subrufescentoides** sp. nov.

Pileus convex to subexpanded, slightly umbonate, thick and fleshy, solitary, reaching 10 cm. broad; surface dry, smooth, whitish, densely covered with imbricate, delicately-fibrillose, rufescent scales, except at the center, where it is glabrous and fulvous to bay; lamellae free, rather close, ventricose, pallid to pale-purplish; spores narrowly ellipsoid, obliquely pointed at the base, smooth, pale purplish-brown, 6–7 × 3.5 μ; stipe tapering upward, not bulbous, glabrous, white, staining slightly reddish-brown when bruised, 7 cm. long, 1–1.5 cm. thick; annulus ample, membranous, simple, white, staining slightly reddish-brown, fixed, superior.

Type collected on the ground in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 591*. Also collected near Tacoma, Washington, October 26, 1911, *W. A. Murrill 720*.

17. **Agaricus McMurphyi** sp. nov.

Pileus rather thick and fleshy, convex to expanded, solitary, 15 cm. broad; surface moist, smooth, light-gray with purplish-brown fibrils, margin somewhat ragged with portions of the veil; context white, not changing when bruised, with taste and odor similar to that of *A. campestris;* lamellae free, several times inserted, rather broad, ventricose, crowded, becoming very dark brown; spores ellipsoid, smooth, dark-purplish under a microscope, 5–6 × 3–3.5 μ; stipe subequal with a prominent bulb, subglabrous, stuffed, whitish below to purplish-brown above, 13 cm. long, 2 mm. thick; veil thin, membranous, leaving a permanent, median annulus.

Type collected on the ground under redwoods near Searsville Lake, California, January 6, 1903, *James McMurphy 35*.

18. **Agaricus crocodilinus** sp. nov.

Pileus thick, convex, not fully expanding, solitary, reaching 35 cm. broad; surface white, conspicuously ornamented with large gemmate warts originating from the cracking of the epidermis, causing it to resemble the skin of a crocodile; lamellae broad, ventricose, crowded, narrowed behind; spores ellipsoid, obliquely pointed at the base, smooth, uniguttulate, dark purplish-brown, $11–13 \times 6–7\,\mu$; stipe short, white, smooth, glabrous, 12×6 cm., very much inflated at the center, where it reaches 9 cm. or more thick; veil superior, white, membranous. (*pl. 77.*)

Type collected on the ground at Ferndale, Humboldt Co., California, by H. J. Smith, who tested it and found it edible.

2. STROPHARIA (Fries) Quél. Champ. Jura Vosg. 110. 1872

1. STROPHARIA AERUGINOSA (Curt.) Quél. Champ. Jura Vosg. 110. 1872

California, *Harper 7;* Stanford University, California, *McMurphy 151.*

2. STROPHARIA SEMIGLOBATA (Batsch) Quél. Champ. Jura Vosg. 112. 1872

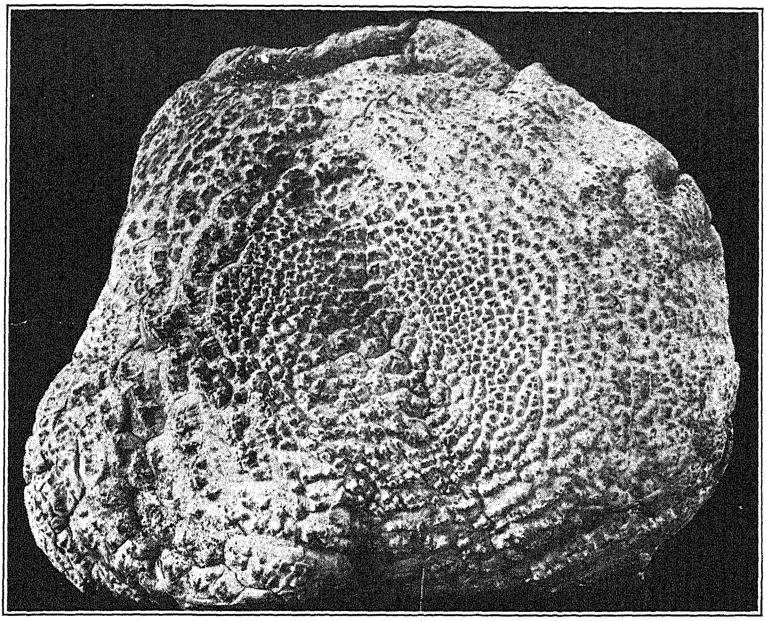
See MYCOLOGIA for January, 1912, where this species is described and illustrated in color.

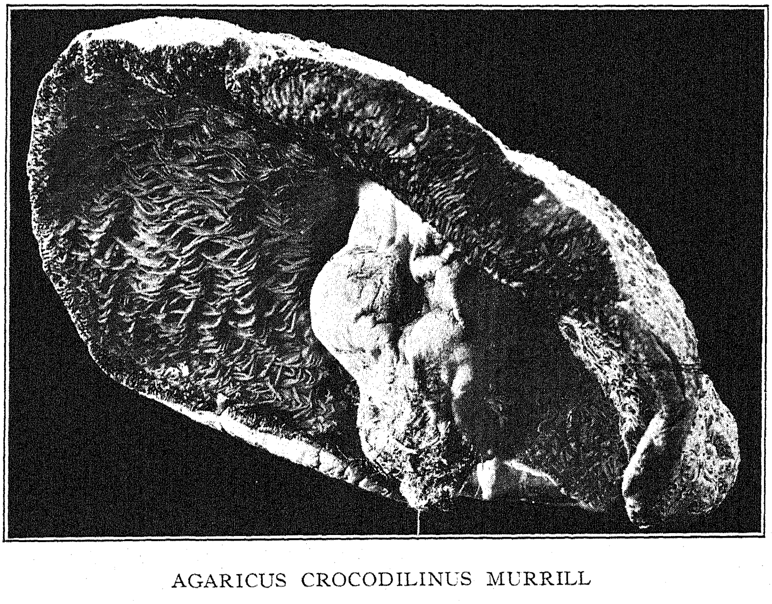
Tacoma Prairies, Washington, *Murrill 713;* Corvallis, Oregon, *Murrill 970, 973, 997*; Stanford University, California, *Dudley 184, Miss Kidwell 95, McMurphy 112;* Searsville Lake, California, *McMurphy 98.*

3. STROPHARIA STERCORARIA (Fries) Quél. Champ. Jura Vosg. 112. 1872

Similar to *S. semiglobata* in habit and appearance, but gills becoming brownish-black or greenish-black instead of cloudy-black, and spores larger and lighter in color, appearing olivaceous under a microscope. The spores of both species are immense and vary considerably in size.

Stanford University, California, *Miss Patterson 15, 30, 40,*





AGARICUS CROCODILINUS MURRILL

Dudley 75, Nohara 40, Abrams 200; near Palo Alto, California, *Baker 377;* Berkeley, California, *Harper;* near Searsville Lake, California, *McMurphy 47.*

4. STROPHARIA MAGNIVELARIS Peck; Harriman Alaska Exped. Crypt. 44. 1904

Pileus convex, becoming nearly plane, sometimes umbonate, glabrous or obscurely radiately fibrillose or fibrillose-squamose with innate or appressed fibrils, ochraceous-buff when dry; lamellae moderately close, blackish-brown when mature; stems long, slender, glabrous, solid, slightly thickened at the base, whitish, the ring large, membranous, white, persistent; spores ellipsoid-oblong, 14–16 μ long, 7–8 μ broad.

Pileus 2–3 cm. broad; stem 5–7 cm. long, 2–4 mm. thick.

Described from specimens collected on the ground at Yakutat Bay, Alaska, *Trelease 501, 503.* The types at Albany resemble *S. stercoraria,* but have a larger ring, darker gills, and a more radiate-rugose or subsquamose cap.

5. **Stropharia semigloboides** sp. nov.

Pileus convex, thin, solitary, 1.5 cm. broad; surface smooth, glabrous, shining, somewhat viscid when young, cremeous, ochraceous at the center; lamellae adnate, plane, distant, pale-grayish to fumosous, the edges white; spores oblong-ellipsoid, smooth, 2-guttulate, subhyaline with a faint yellowish-brown tint under a microscope, $8 \times 4 \mu$; stipe radicate, tapering upward, smooth, glabrous, white, slightly tinted with yellow at the base, 10 cm. long, including the root, 5–8 mm. thick; veil ample, white, fixed, persistent, fimbriate at the margin, colored above with the purplish spores.

Type collected among leaves in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 435.* Resembling *Stropharia semiglobata,* but differing in habitat, with much paler gills and different spore characters.

6. **Stropharia longistriata** sp. nov.

Pileus conic to convex, more or less umbonate, thin, gregarious, 2.5–5 cm. broad; surface hygrophanous, glabrous, radiate-rugose, isabelline to dark-cream on the umbo, whitish to dull-brown on the long-striate margin; lamellae adnate, narrow, plane, not

crowded, often whitish on the edge, pallid to purplish-brown; spores ellipsoid, smooth, 1–2-guttulate, pale-purplish under a microscope, $7 \times 3.5\,\mu$; stipe milk-white throughout, smooth, glabrous, tapering upward, hollow, about 6 cm. long and 5 mm. thick; annulus very large, persistent, median, fixed, funnel-shaped.

Collected in abundance on rich earth and decayed chips in an opening in woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 233* (*type*), *527, 604, Zeller 89, 122.* Also collected on the ground among dead sticks in woods at Newport, Oregon, *W. A. Murrill 1074.* Similar to *Hypholoma appendiculatum* in general appearance, but always furnished with a conspicuous, persistent annulus.

7. STROPHARIA BILAMELLATA Peck, Bull. Torrey Club **22**: 204. 1895

Pileus fleshy, convex, even, whitish or yellowish, flesh pure-white; lamellae close, adnate, purplish-brown when mature; stem short, solid, white, with a well-developed pure-white annulus which is striately lamellate on the upper surface; spores ellipsoid, purplish-brown, 10×5–$6\,\mu$.

Pileus 2.5–5 cm. broad; stem about 2.5 cm. long, 6–8 mm. thick.

Described from specimens collected by McClatchie (840) in grass on the streets of Pasadena, California. With the types at Albany, are specimens collected by Braendle at Washington, D. C., which appear to be identical.

3. DROSOPHILA Quél. Ench. Fung. 115. 1886

It seems best to separate the genus *Hypholoma* as ordinarily known into two groups, one containing the densely cespitose species, such as *H. sublateritium*, which form a natural group, and the other containing *H. appendiculatum, H. lacrymabundum*, and their relatives.

1. DROSOPHILA APPENDICULATA Quél. Ench. Fung. 116. 1886

Hypholoma appendiculatum (Bull.) Quél. Champ. Jura Vosg. 115. 1872.

Hypholoma cutifractum Peck, Bull. Torrey Club **22**: 490. 1895.

Hypholoma flocculentum McClatchie Proc. S. Cal. Acad. Sci. 1: 381. 1897.

Described and figured in MYCOLOGIA for January, 1912. A very abundant and widely distributed edible species.

California, *Miss Patterson, H. S. Fawcett, McClatchie, Baker.*

2. **Drosophila atrofolia** (Peck)

Hypholoma atrofolium Peck, Bull. Torrey Club 23: 417. 1896.

Pileus submembranous, at first convex or hemispheric, then broadly convex, commonly umbonate, minutely and irregularly furrowed, striate to the apex when mature, hygrophanous, burnt-umber or wood-brown when moist, fading to pale-tawny or cream color in drying, veil fugacious; lamellae subdistant, adnate, at first pale-brown or drab, then dark seal-brown, almost black; stem slender, fibrillose, hollow, pallid or cream color; spores very dark brown, ellipsoid, $10 \times 5\,\mu$; pileus 18–48 mm. broad; stem 2.5–6 cm. long, 2–3 mm. thick.

Described from plants collected by McClatchie among bushes at Pasadena, California. At Albany, specimens from California collected by Copeland and also from Ohio collected by Lloyd bear this name. The gills of the type are almost black when mature, suggesting *Psathyrella,* but its relationships are nearer *Hypholoma,* according to the author.

3. **Drosophila longipes** (Peck)

Hypholoma longipes Peck, Bull. Torrey Club 22: 204. 1895.

Pileus thin, campanulate, even or obscurely striate on the margin, fibrillose becoming glabrous, hygrophanous, yellowish-brown when moist, brown or isabelline-brown when dry, the margin appendiculate with the very white, floccose, fugacious veil; lamellae narrow, close, adnate, white or whitish, becoming nearly black, often whitish on the edge; stem slender, long, hollow, striate at the top, white, with a mycelioid tomentum at the base; spores ellipsoid, $12.5 \times 7.5\,\mu$.

Pileus 2.5–3 cm. broad; stem 5–12.5 cm. long, 2–5 mm. thick.

Described from specimens collected by McClatchie in very wet weather among fallen leaves near Pasadena, California. Very thin and fragile, with stipe hollow to the very apex. Specimens at Albany from California sent to Dr. Peck by Miss Patterson in 1907 are incorrectly referred to this species.

4. **Drosophila campanulata** (Peck)

Hypholoma campanulatum Peck, Bull. Torrey Club **36**: 336. 1909.

Pileus thin, campanulate, dry, somewhat shining, glabrous, sometimes slightly appendiculate with fragments of the white veil, ochraceous; lamellae thin, close, nearly free, pale-brown becoming dark-brown, whitish on the edge; stem long, equal, glabrous, hollow, white or cream-colored with a soft white tomentum at the base; spores blackish-brown, ellipsoid-oblong, 8–10 × 4–5 μ.

Pileus 3–4 cm. broad; stem 8–13 cm. long, 4–7 mm. thick.

Described from specimens collected by Baker in open ground among shrubs, grass, and weeds, at Claremont, California. Probably too closely related to *H. longipes* Peck, according to specimens examined at Albany.

5. **Drosophila californica** (Earle)

Hypholoma californicum Earle, Bull. N. Y. Bot. Gard. **2**: 344. 1902.

Densely cespitose on or near the base of oak stumps; pileus thin, 5–5.5 cm., convex, then expanded and subumbonate, deep rich-brown, smooth, hygrophanous, margin entire (or obscurely striate in dried specimens); lamellae adnexed or subfree, subcrowded, slightly ventricose, pale-brown at first then darker; spores dark purplish-brown, oblong-ellipsoid, 5–6 × 3 μ; veil white, of thin fibers soon breaking away from the stem but more closely woven toward the margin, appendiculate; stalk 7–10 cm. × 4–5 mm., equal, glabrous but uneven with small irregular swellings, sordid-white marked with brownish stains on drying, hollow, cartilaginous, fragile, often splitting; flesh thin, pale-brownish, unchanging, taste and smell mild (normal agaric).

Described from specimens collected on the summit of the Coast Range, near Palo Alto, California, *Baker 86*. Related to *H. longipes* Peck, but larger, with ventricose gills and smaller spores.

6. **Drosophila ambigua** (Peck)

Hypholoma ambiguum Peck, Bull. Torrey Club **25**: 325. 1898.

Pileus thin, convex, becoming nearly plane, glabrous, subviscid when moist, straw color inclining to pale-orange, the mar-

gin in immature plants appendiculate with the remains of the white, thick veil which in very young plants conceals the lamellae, but which in mature ones wholly disappears; flesh white; lamellae close, adnexed, grayish at first, changing to dark-brown where wounded, becoming blackish-brown with age; stem slender, equal, stuffed or hollow, squamose near the base, paler than the pileus; spores ellipsoid, $12.5–15 \times 7.5\,\mu$.

Pileus 5–13 cm. broad; stem 12–22 cm. long.

Described from specimens collected by Lane in fir woods near Portland, Oregon, in November. The species belongs naturally in *Stropharia,* but the large veil is entirely appendiculate and leaves no annulus. It is one of the most striking and abundant gill-fungi on the Coast.

Seattle, Washington, *Murrill 245, 594, 649, Zeller 91;* Mill City, Oregon, *Murrill 868;* Corvallis, Oregon, *Murrill 929;* Salem, Oregon, *M. E. Peck;* Muir Woods, California, *Murrill 1131;* La Honda, California, *Murrill & Abrams 1272;* Searsville Lake, California, *McMurphy 92, 117.*

4. HYPHOLOMA (Fries) Quél. Champ. Jura Vosg. 112. 1872

Most of the collections cited under the two species listed below are without notes, and microscopic characters are of little assistance here. Persons using these specimens for comparison are therefore advised to do so with caution, depending rather upon fresh material and good descriptions.

1. HYPHOLOMA CAPNOIDES (Fries) Sacc. Syll. Fung. 5: 1028. 1887

This species is rare on the Coast. It differs from *H. fasciculare* in having smoky-blue to purplish-brown gills and a mild taste. It is not credited with having cystidia, nor occurring on deciduous wood.

Seattle, Washington, *Murrill 473, 521, 687;* Salem, Oregon, *M. E. Peck;* Muir Woods, California, *Murrill 1128.*

2. HYPHOLOMA FASCICULARE (Huds.) Quél. Champ. Jura Vosg. 113. 1872

This species occurs in the greatest profusion on dead wood of all kinds. The gills are sulfur-yellow to greenish and at length purplish-brown with a greenish tint. The flesh is yellow and intensely bitter, according to descriptions. The spores are ellipsoid, smooth, pale-yellow, becoming purplish-brown, 6–7 × 4 μ, and cystidia are said to be present, measuring 40–50 × 10–12 μ.

Seattle, Washington, *Murrill 429, 501, Zeller 92;* Corvallis, Oregon, *Murrill 886;* Salem, Oregon, *M. E. Peck;* Golden Gate Park, San Francisco, California, *Miss Eastwood 14, 15;* Marin County, California, *Miss Eastwood 11;* Mt. Tamalpais, Marin County, California, *Miss Eastwood 33;* Berkeley, California, *Harper 20;* Sutro Woods, California, *Harper 59;* California, *Harper;* Searsville Lake, California, *McMurphy 32;* Stanford University, California, *McMurphy 155;* Monterey, California, *Dudley 125;* Santa Cruz, California, *G. J. Streator;* Santa Cruz Mountains, California, *Dudley 108.*

5. GOMPHIDIUS Fries, Gen. Hymen. 8. 1836

1. GOMPHIDIUS OREGONENSIS Peck, Bull. Torrey Club **25**: 326. 1898

Pileus at first convex, becoming nearly plane or somewhat centrally depressed, viscid, brown or dark-brown, becoming black in drying, taste sweet and pleasant; lamellae numerous, rather close, adnate or slightly decurrent, blackish in the dried plant; stem short, solid, equal or slightly tapering upward, colored like the pileus; spores oblong, 10–12.5 μ long, 4–5 μ broad.

Pileus 5–10 cm. broad; stem 2.5–5 cm. long, 4–10 mm. thick.

Described from specimens collected by Dr. H. Lane in fir woods in Oregon. According to Dr. Lane, it grows there by the wagon load and is edible. I found it common both in Washington and Oregon. Baker states that the gills are brightly phosphorescent. The spores are translucent with a blackish tint under a microscope and measure 11–13 × 3.5–4.5 μ, while in the very closely related *G. nigricans,* described by Peck from New York in 1896, the spores are 15–25 × 6–7.5 μ.

Seattle, Washington, *Murrill 255, 324, 500, 682;* Tacoma Prairies, Washington, *Murrill 706;* Corvallis, Oregon, *Murrill 968;* La Honda, California, *Murrill & Abrams 1242;* Stanford University, California, *Baker 155;* Santa Cruz, California, *G. J. Streator;* Berkeley, California, *Harper 22.*

2. GOMPHIDIUS VINICOLOR Peck, Ann. Rep. N. Y. State Mus. 51: 291. 1898

Pileus thick, fleshy, convex or nearly plane, viscid, dark-red, becoming blackish in drying; lamellae distant, decurrent, olive-brown or blackish when mature, stem subequal, glabrous, solid, vinous-red, paler within; spores oblong-fusiform, $12–14 \times 3.5–4\ \mu$.

Pileus 2.5–6 cm. broad; stem 3–6 cm. long. 4–8 mm. thick.

Described from specimens collected under pine trees at Lake Mohonk, New York. The western plants are larger and have spores measuring about $17.5 \times 5\ \mu$. The spore print is olivaceous, while under a microscope the spores are translucent with olivaceous tints.

Stanford University, California, *McMurphy 111, Dudley 166;* Golden Gate Park, San Francisco, California, *Miss Eastwood 17, 20, Murrill 1107;* Berkeley, California, *W. C. Blasdale, M. A. Howe, Harper 54.*

3. **Gomphidius tomentosus** sp. nov.

Pileus convex to slightly depressed, gregarious to subcespitose, reaching 6 cm. broad; surface dry, conspicuously cottony-tomentose, ochraceous, discolored-ochraceous to avellaneous at the center, becoming yellowish-brown or pinkish-brown on drying, margin concolorous, incurved, conspicuously decorated with tomentum similar to that on the surface and also with a portion of the fibrillose veil; context ochraceous, becoming reddish-tinted on drying, sweetish to the taste, odor agreeable; lamellae decurrent, distant, inserted, forked at times, rather thick and entire on the edge; spores oblong-fusiform, smooth, translucent or opaque, olivaceous under a microscope, $17.5–21 \times 7–9\ \mu$; stipe similar to the pileus in color and tomentum, inclined to be fusiform in shape, solid, ochraceous within, 8 cm. long, 1.5 cm. thick, with a cushion of long, fibrillose-tomentose hairs, instead of the usual form of annulus.

Type collected on a mossy bank in low woods near Seattle, Washington, October 20–November 1, 1911, *W. A. Murrill 330.* Also collected at the same time by *S. M. Zeller 10,* and by an unknown collector in 1906 on clay soil near Seaside, Oregon. It is an anomalous species, not suggesting *Gomphidius* when first seen, but it has several characters in common with *G. vinicolor,* including the very characteristic spores.

NEW YORK BOTANICAL GARDEN.

TYPE STUDIES IN THE HYDNACEAE[1]
II. THE GENUS STECCHERINUM

Howard J. Banker

The genus *Steccherinum* was established by S. F. Gray[2] on *Hydnum ochraceum* Pers. as the type. In Persoon's herbarium, now preserved in the University of Leyden, there is a specimen marked in what is believed to be Persoon's hand: "Hydnum ochraceum (junius? resupinatum) Prope Parisios." The specimen has been peeled from the substratum and glued tight to the sheet, hymenial surface down. It is nearly wholly resupinate, the margin being only slightly reflexed. In consistency of substance and character of teeth, so far as they could be made out, the specimen appeared to be identical with American plants commonly referred to this species.

As we have observed the plant in this country it presents a considerable degree of variation, from very thin sheets with slightly reflexed margins to much thicker layers with distinct prominent pilei. The typical form of the plant as suggested by Persoon's specimen and figure,[3] as well as by Sowerby's figure of *Hydnum Daviesii*,[4] believed to be a synonym, compared with our American plants most nearly like these, appears to be a thin, separable, membranous subiculum more or less reflexed at the margin into numerous thin flabelliform pilei. This typical form of the plant does not appear to be common with us and is usually found on the lower side of large prostrate limbs, spreading upward on the sides of the substratum until compelled to become reflexed to preserve the plagiotropic position of the hymenium. A more common form with us has a thicker subiculum and is usually found growing on the vertical side of standing trunks of various

[1] Investigation prosecuted with the aid of a grant from the Esther Herrman Research Fund of the New York Academy of Science.

[2] Nat. Arr. Brit. Pl. 1: 651. 1821.

[3] Persoon, Syn. Meth. Fung. *pl. 5. f. 5.*

[4] Sowerby, Eng. Fung. *pl. 15.*

deciduous trees, covering spots injured by fire or otherwise. The plant here grows spreading in a vertical position and forms numerous imbricated, campanulate, and often pendent pilei of considerable thickness. I have seen a quarter of an acre of young white oak twenty or twenty-five years old in which nearly every tree had a spot on one side near the ground and extending up the trunk for one or two feet bare of bark and covered with the sporophores of this plant. Whether the fungus had attacked the living tree and produced these decayed spots or whether the spots had been killed by other means and the fungus had taken possession could not be positively determined. But I think the latter was probably the case. It has seemed sometimes as though this form was a distinct species, but I have found fallen limbs of these same oaks on which the fungus developed too closely the characters of the typical *H. ochraceum* to warrant its being separated as a separate species.

Steccherinum dichroum (Pers.)

Hydnum dichroum Pers. Myc. Eur. **2**: 213. 1825.
Hydnum pudorinum Fries, Elench. **1**: 133. 1828.

The only specimen in Persoon's herbarium throwing any light on this species was one sent to Persoon by Delastre marked "hydnum rubiginosum Dre" and renamed in Persoon's hand "Hydnum dichroum." As Persoon cites Delastre for his specimen, it is probable that this is the type specimen. In consistency and character of teeth the plant closely resembles *Steccherinum ochraceum*, but differs in its thicker subiculum and more flabelliform pilei. The plant perhaps approaches too near *S. Rhois* (Schw.) to be regarded as a distinct species. There is, however, a fairly well defined group of forms intermediate between *S. ochraceum* and *S. Rhois*, of which this specimen appears to be typical and which may, therefore, be regarded as constituting the species *S. dichroum* (Pers.).

At Upsala, specimens of similar character were referred uniformly to *Hydnum pudorinum* Fr. From the late date of most of these specimens it is improbable that they were ever seen by E. Fries. A single specimen (of older date) was found, apparently received from Delastre and marked in Delastre's hand

"hydnum rubiginosum Dre. 1823,—Dichroum Pers. Myc. Eur. sect. 2 add[d] Pag. 213." Below this appeared in a different hand "pudorinum Fr." This plant differs considerably from the specimen in Persoon's herbarium, likewise received from Delastre, and approaches more nearly *S. ochraceum*. It is possibly the specimen to which Fries refers in "Hymenomycetes Europeae" 612. Fries himself regarded *Hydnum dichroum* Pers. as a synonym of his *H. pudorinum* and it seems best that the names should be regarded as synonyms, but the older name of Persoon has priority and the species should be known as *Steccherinum dichroum* (Pers.).

STECCHERINUM RHOIS (Schw.) Banker, Mem. Torrey Club **12**: 126. 1906

Hydnum Rhois Schw. Syn. Fung. Car. Sup. 77. 1818.
Hydnum flabelliforme Berk. Lond. Jour. Bot. 4: 306. 1845.

The type of *H. Rhois* Schw. in the Schweinitz herbarium at Philadelphia has disappeared. In the Berkeley herbarium at Kew, England, a specimen was found marked "Hydnum Rhois L. v S. Herb. Schwein." and is presumably a part of the original Schweinitz specimen. This particular specimen is somewhat smaller than the type of *Hydnum flabelliforme* Berk. preserved in the same herbarium and approaches somewhat closely to *Steccherinum dichroum* (Pers.), but in most of its characters is essentially the same as *Hydnum flabelliforme* Berk. Comparison with extensive collections of our American forms convinces me that *H. Rhois* cannot be successfully separated from *H. flabelliforme*.

The entire series of forms included under these three species, *Steccherinum ochraceum* (Pers.), *S. dichroum* (Pers.), and *S. Rhois* (Schw.), constitute a closely continuous series in which over refinement of species making might be able to segregate some five or six more or less clearly defined forms. We believe, however, that the three species enumerated is as close a segregation as the group will bear and it may even be reasonably questioned whether these species are anything more than extreme variations of a single fundamental type. It seems to be possible to obtain an almost complete blending of the species by intermediate forms, some of which perhaps are really represented by

the synonyms. Thus *H. pudorinum* Fr. might be regarded as a form intermediate between *H. ochraceum* Pers. and *H. dichroum* Pers., while *H. Rhois* Schw. strictly interpreted is perhaps intermediate between *H. dichroum* Pers. and *H. flabelliforme* Berk.

Steccherinum rawakense (Pers.)

Hydnum rawakense Pers. Freyc. Voy. Aut. du Monf. Bot. 175. 1826.

Hydnum reniforme Berk. & Curt. Jour. Linn. Soc. **10**: 325. 1869.

Hydnum glabrescens Berk. & Rav. Grev. **1**: 97. 1873.

Hydnum guaraniticum Speg. Fung. Guar. 34. 1883.

Hydnum basi-asperatum Henn. Hedw. **36**: 199. 1897.

No type of *H. rawakense* Pers. was found in Persoon's herbarium at Leyden, but in the Herbarium of Paris there was found a specimen with the following label apparently in Persoon's hand; "37 hydnum rawakense Rawak. C. Sandrenaud," and then there was added in a different hand "spec. Persoonianum." The specimen would appear to be in all probability the type of the species. It is discolored as though it had some time been poisoned, and has evidently been formerly glued to a sheet teeth down, the teeth being gummed up with the glue.[5] In spite of these deformities, there appears to be but one group of forms to which it could belong, a species that ranges from the West Indies through South America and the islands of the Southern Pacific. The most distinctive features of the species are the thin, submembranous, spreading pilei, the pubescent, ochraceous surface with a somewhat clearly marked central or basal disk and a broad marginal portion marked with more or less distinct light and dark zones. At Berlin specimens of this species were noted from Brazil and from New Guinea, the latter having the margin distinctly lobed.

The type of *H. reniforme* B. & C. is in the Berkeley herbarium at Kew and is marked "301 Hydnum reniforme Bk. Cuba, Wright, (Curtis)." It appears to be unquestionably the same thing as *H. rawakense* Pers. The specimen at Kew, "Ravenel No. 1634," the type of *H. glabrescens,* appears to me to be prob-

[5] In Persoon's herbarium several specimens were observed mounted in this unusual manner. See *S. ochraceum*.

ably this same species, but is not quite typical, having a thicker pileus, and is a little darker colored.

At Paris a specimen was found evidently distributed by Spegazzini as an authentic specimen of his *H. guaraniticum* from Paraguay, June, 1883. The plant appeared to have all the characters of *H. rawakense* Pers.

The type of *H. basi-asperatum* Henn. is in the Berlin herbarium, Germany, and was collected by E. Ule in Brazil, No. 743. The plant has precisely the texture, color, and tooth characters of *Steccherinum rawakense* Pers. It appears to have been a plant that when half grown had been turned over so as to bring the hymenial side upward and had then proliferated a series of confluent pilei from its margin, giving the margin a lobed appearance. The hymenial layer of these new growths has spread back over what was the upper surface of the old pileus, forming a continuous layer which is interrupted, however, at one point where the characters of the upper surface of the old pileus are revealed. The teeth on the old lower surface now exposed upward have become darkened and appear weathered somewhat, but are still distinctly teeth and not hairs or tomentum. With this explanation the plant is identical with Moller's specimens in the same herbarium mentioned by Hennings in his original description. This curious mare's-nest is figured true to the specimen in Engler und Prantle, Die naturl. Pflanzenf. I. 1**: 145. *f. 77. c–e.*

Steccherinum pusillum (Brot.)

Hydnum pusillum Brot. Fl. Lus. **2**: 470. 1804.

Steccherinum adustulum Banker, Mem. Torrey Club **12**: 133. 1906.

The type of *H. pusillum* Brot. is probably not in existence. At both Kew and Upsala were found specimens from Quélet referred in some cases to *Hydnum pusillum* Fr., in others to *H. pusillum* Quél. and at Upsala the sheet itself was marked "Hydnum pusillum Brot." All of these specimens were undoubtedly the same as my *Steccherinum adustulum*. The species is, therefore, a European form as well as American, and Brotero's description so well fits the characters of the plant as we know it that there seems to be no reasonable doubt that his name should prevail for this species.

Steccherinum Peckii sp. nov.

Hymenophore pileate narrowing into a lateral stipe; pileus flabelliform, horizontal, confluent laterally, 0.5–1 cm. wide, by confluence often 3 cm. wide, 0.5–1.5 cm. long, thin, less than 1 mm. thick; surface glabrous or slightly puberulent, radiately rugose, subsulcate-zonate, light-buff, concentrically zonate with fine dark lines; margin thin, subrepand; substance fibrous, dry, brittle; stipe lateral, more or less compressed vertically, attenuate to base, usually distinct, occasionally confluent, concolorous with pileus, 1–8 mm. long by 1–5 mm. wide; hymenium ochraceous, more or less sharply delimited toward the stipe; teeth crowded, short, often decurrent as papillae on the stipe, ochraceous to buff, terete to compressed, sometimes forked, whitish-puberulent with free clavate hyphal ends, 1–2 mm. long, 9–12 to a sq. mm.; spores elliptical or oblong, smooth, hyaline, granular, 2–2.5 × 3–3.5 μ; hyphae hyaline, firm-walled, elastic, compactly woven, infrequently septate; tasteless; odorless.

On dead maple limbs in autumn at Griffin's Corners, Delaware County, N. Y. Collected by C. H. Peck.

Type in the writer's herbarium and in the New York State herbarium at Albany, N. Y.

This elegant species is closely related to *Steccherinum Rhois* (Schw.), from which it is clearly distinguished by the nearly or quite glabrous surface of the pileus and by the sharply defined, concentric, dark lines. The surface has a somewhat silky lustre and this with the color markings and the graceful, clearly defined form of the pileus renders the species especially attractive. I take pleasure in dedicating this handsome species to the collector, our mycological Nestor, Dr. C. H. Peck, State Botanist of New York.

Steccherinum basi-badium sp. nov.

Hymenophore pileate, sessile to substipitate, somewhat confluent; pileus dimidiate to orbicular, horizontal or ascending, 0.5–1.5 cm. wide, 0.5–1 cm. long, 0.2–0.3 mm. thick; surface sulcate-zonate, radiately subrugose, glabrous, light-buff at margin, becoming abruptly darker, umbrinous to badious toward base; margin very thin, acute, substerile, incurved; substance fibrous, dry, scarcely brittle, buff to ochraceous below, badious above; teeth crowded, delicate, slender, subterete to compressed, tips minutely forked or fimbriate, 0.3–0.5 mm. long × 0.1 mm. wide, pale-buff to ochraceous, puberulent with free clavate hyphal ends; spores not

observed; hyphae hyaline, firm-walled, elastic, infrequently septate, clamp-connections occasional, not easily separable in KOH; tasteless; odorless.

Mexico. Collected by W. A. Murrill.

Type (Murrill 253) in the New York Botanical Garden.

The species appears to be closely related to *Hydnum rawakense* Pers. and *S. Peckii,* but is more delicate, with a thinner pileus, and is clearly distinguished by the dark brown disk and base.

STECCHERINUM MORGANI Banker, Mem. Torrey Club **12**: 127. 1906

As has already been stated, the type of *Hydnum glabrescens* Berk. & Rav. is No. 1634 Ravenel, with which Berkeley also associated No. 385 Thwaites. These specimens are preserved in the Berkeley herbarium at Kew, England. No. 1634 has every appearance of being *Steccherinum rawakense* (Pers.), q. v., but is not quite typical. No. 385 is simply marked "385 Hydnum glabrescens B. & Rav." and is without any date or locality indicated. The specimen is badly worm-eaten and a mere scrap, but does not appear much like No. 1634. It does resemble another specimen in the herbarium marked "Hydnum glabrescens B. & R." in Berkeley's hand. To this specimen is attached a slip with the following memorandum: "A form apparently of no. 385 sent before. Hydnum Central Province Dec. 1868," probably a note by Thwaites. This specimen is also in poor condition. A third specimen with these has no name attached, but is marked "Ceylon 1866 G. H. K. T." This specimen is in much better condition than the others and strikingly resembles the plants that I described as *Steccherinum Morgani loc. cit.* from specimens collected by A. P. Morgan in Ohio.

These three specimens so far as can be judged are apparently all one species and were probably all collected by Thwaites in Ceylon. On the testimony chiefly of the last specimen they seem to approach closely to the Morgan plants, yet the specimens were too poor to draw positive conclusions. In the Cooke Herbarium, also now preserved at Kew, was found a specimen marked simply "Hyd. glabrescens B. & R. Ceylon." This was so perfectly identical with the Morgan plants in every way that it seemed not

only that it was the same species but must have been collected under precisely the same conditions, in fact, it appeared to be part of the same collection. It seemed impossible that plants not known to be cosmopolitan could have developed in regions so remote and of so different environmental conditions as in Ceylon and Ohio and have produced such perfect identity of characters. Two plants could not possibly be any more perfectly alike. Knowing that Cooke had received some of Morgan's specimens, it seemed too probable that there had been an error in labeling and that the specimen should have been marked Ohio instead of Ceylon. Later, however, at South Kensington in the Broome Herbarium there was found a specimen just as perfectly identical with the Morgan specimens as was the Cooke specimen and this was marked "Hydnum Ceylon. G. H. T. 1854." There appeared to be no reason to doubt that this was truly a Ceylon plant and hence that the Cooke specimen was also correctly labeled. It seems, therefore, conclusively demonstrated that plants identical in every respect with the type of *Steccherinum Morgani* were collected in Ceylon by G. H. K. Thwaites between 1854 and 1868, and that No. 385 is in all probability one of these plants.

The South Carolina plant of Ravenel, No. 1634, does not belong to this species. It is also evident that Berkeley had the Ravenel plant in mind as the type of his *H. glabrescens* not only from the fact of his having described the species in a work on North American fungi, but also from the fact that when he placed any name on the Ceylon plants it was with the ascription "B. & Rav." or "B. & R." It seems clear, therefore, that the name was first given to the American plant and the Ceylon specimens were then referred to this species, as we believe, erroneously.

Steccherinum laeticolor (Berk. & Curt.)

Hydnum laeticolor Berk. & Curt. Grev. **1**: 99. 1873.

The type of this species according to the citation of Berkeley is Curtis 2930, with which are associated other specimens from the South, as Beaumont 4647, 5166, and Ravenel 894. These specimens are all in the Berkeley Herbarium at Kew. The species as thus represented is a clearly defined segregation some-

what resembling *Steccherinum ochraceum* (Pers.) in general appearance, but readily distinguished by its soft spongy or almost cotton-like substance and its pronounced reddish color when young and fresh, but this color fades out considerably with age and weathering. There seems to have been no confusion respecting the species and it is correctly represented in the Exsiccati of Ravenel, Fung. Car. Exsicc. **3**: 18; and Ellis and Everhart, N. Am. Fung. 2nd Series, 2015. The species appears to be confined wholly to the southern states.

Steccherinum multifidum (Kl.)

Thelephora multifida Kl. Linnaea **25**: 365. 1852.
Hydnum plumarium Berk. & Curt. Jour. Linn. Soc. **10**: 324. 1869. Not *H. plumarium* Berk. & Curt. Grev. **1**: 97. 1873.

There is reason for some doubt as to whether this species should be included in the genus *Steccherinum* or not. It does not appear to have closer affinities with any other genus and if removed would have to be erected into a genus by itself. The principal departure from the generic type is in the character of the hymenial surface, which consists of poorly developed but closely anastomosing ridges more or less cut up into flattened, conical, or cylindrical teeth. In this respect the plant shows some affinity to the genus *Phlebia* and in places the anastomosation becomes so close as to form alveolar pores, suggesting a close relationship to *Favolus* of the Polyporaceae.

The type of *Thelephora multifida* Kl. is preserved in the Berlin herbarium and is marked "No. 14c. Thelephora (Merisma) multifida Kl. Portorico. Schwanecke." The specimen has the hymenial ridges and teeth so more than usually poorly developed as to be scarcely noticeable, hence the plant was referred to *Thelephora*. The teeth, however, are present in places, and Hennings recognizing them referred the specimen to *Hydnum*.

The type of *Hydnum plumarium* B. & C., Jour. Linn. Soc. **10**: 324, is given by Berkeley as "205" Cuban Fungi. In the Berkeley herbarium at Kew, the specimen is marked "205 Hydnum plumosum B. & C., Cuba, Wright (Curtis)." It is an excellent specimen of the same species as *Thelephora multifida* Kl. It is entirely distinct from *Hydnum plumarium* B. & C., Grev. **1**:

97, as may be determined by comparison of the descriptions, and is confirmed by the types at Kew.

The study of numerous specimens of *Steccherinum multifidum* (Kl.) at Berlin, Kew, New York Botanical Garden, and in the writer's herbarium show the plant to vary considerably in the degree of development of the hymenial ridges and teeth, and always there is more or less interruption in the extent of these features, so that many parts of the hymenial surface appear nearly smooth. The margin of the pileus also varies greatly from barely fimbriate to deeply laciniate.

The plant appears to be of fairly common occurrence but is confined to the region of the West Indies.

DOUBTFUL SPECIES

HYDNUM DECURRENS B. & C., according to Berkeley, is based on plants collected by Wright in Cuba and sent to Berkeley by Curtis, Nos. 234 and 297. The specimens are at Kew and No. 234 is a fragment of little value. No. 297 is a good complete specimen identical in every respect with specimens distributed in "Fungi Cubenses Wrightiani," No. 346, as "Hydnum decurrens." The plants appear to be too near *Steccherinum ochraceum* (Pers.).

HYDNUM PLUMARIUM Berk. & Curt. Grev. **1**: 97. 1873. Not *H. plumarium* Berk. & Curt., Jour. Linn. Soc. **10**: 324. 1869. The type according to the citations of Berkeley is "4936 Car. Sup." The specimen at Kew marked "4936 *Hydnum plumarium* B. & C. Car. Sup. on Viburnum" appears to be a pale, perhaps weathered, specimen of *Steccherinum laeticolor* B. & C., but the material is too scanty to be of much value.

HYDNUM CONCHIFORME Sacc. Syll. Fung. **6**: 458. 1888, was proposed as a substitute for *Hydnum plumarium* B. & C. above and hence is based on the same material as type.

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ACHLYA DeBARYANA HUMPHREY AND THE PROLIFERA GROUP

W. C. Coker

(With Plate 78, Containing 13 Figures)

Achlya DeBaryana Humphrey is the *Achlya polyandra* of DeBary, *not* of Hildebrand, as Humphrey has shown;[1] and as Hildebrand's name is the older and applies to another plant, Humphrey's name should be used. Recent writers on the morphology of this species have ignored this and still call the plant *Achlya polyandra* DeBary. There are now recognized three very closely related species, forming what was called by Humphrey the *prolifera* group, which from the work of recent writers are becoming more and more difficult to separate. They are *Achlya prolifera* (Nees) DeBary, *A. DeBaryana* Humphrey, and *A. americana* Humphrey. Humphrey was himself aware of the very close resemblances of these species and remarked upon it; but on account of DeBary's assurance of the autonomy of the first two, felt called on to continue the distinction. According to DeBary,[2] *A. DeBaryana* (his *A. polyandra*) has antheridial branches that arise from the same main hyphae that bear the oögonia, and then branch and extend out to the oögonia on the branches from which they arose (which is most common) or to oögonia on other threads. In *A. prolifera*, on the other hand, he says that the antheridial branches are diclinous, always arising from other hyphae than the ones that bear the oögonia and that all oögonia are furnished with antheridia. He also says that while *A. prolifera* has oögonia with abundant pits, the oögonia of *A. DeBaryana* is without them. *Achlya americana* has antheridial branches that arise from the same hyphae as the oögonia, and it also has

[1] The Saprolegniaceae of the United States. Trans. Amer. Philos. Soc. 17: 1892.

[2] Untersuchungen über Peronosporeen und Saprolegnieen. Beitr. zur Morph. und Phys. der Pilze, IV Reihe. 1881.

abundantly pitted walls; thus uniting the characters of *A. prolifera* and *A. DeBaryana.*

From the work of Horn,[3] Peterson,[4] and myself it has now become evident that it is no longer possible to distinguish clearly between these species as established by DeBary and Humphrey. Forms are appearing constantly that combine their qualities in so confusing a manner that it is impossible to refer them with certainty. For example, Horn says (l. c., p. 224) that while the plant he describes is undoubtedly near *A. DeBaryana* (*A. polyandra* as he calls it), it cannot with absolute certainty be said to be identical with it; for while in *A. DeBaryana* the antheridia are mostly of androgynous origin, in his plant they are mostly diclinous. He also finds that when cultivated in peptone and in grape sugar or cane sugar certain oögonia show numerous pits.

In his work on Danish Fresh-water Phycomycetes, Peterson (l. c., p. 524) finds, of these three species, only *A. americana.* He places it as a form of *A. DeBaryana* (*A. polyandra,* as he calls it) not as a species, saying that "The reason I do not make use of Humphrey's species-name, but place this species as a variety of *Achlya polyandra* is that I am inclined to regard these pores as variable characters, as there are always some oögonia which have fewer pores than others."

Neither *Achlya prolifera* nor *A. DeBaryana* has so far been described from America. A form that is one or the other or both of these has appeared in my cultures at Chapel Hill for a number of years. It is by far the most abundant *Achlya* in our territory and may be had from springs, ditches and pools at any time of the year. During the spring and summer of this year (1912) I carefully studied the plant in pure cultures from a number of different collections.

To the naked eye, the species may be easily distinguished from others by the very large chlamydospores that usually make a white fringe at the periphery of the cultures. These are often arranged into groups that resemble the branching horns of a deer (fig. 1), or they may be shaped more like a section of *Halameda* (fig. 2). In mature cultures the hyphae become divided up

[3] Annales Mycologici 2: 207. 1904.
[4] Annales Mycologici 8: 294. 1910.

into sections containing dense protoplasm, each section being a chlamydospore. As with other chlamydospores, these will later either become sporangia or give off slender hyphae, sometimes many of them. Sometimes in their formation chlamydospores begin to break apart by bending backward as shown by the apical one in fig. 1. They rarely become entirely detached. The sporangia vary a great deal both in size and shape. At one extreme are those that are large and stout and rounded at the end, as in figs. 3 and 4, and at the other are long, slender forms that are drawn out to a narrow point, which is often bent, as in figs. 5 and 6.

In typical cases the spores on escaping act as usual in species of *Achlya,* forming a rather perfect sphere at the tip of the sporangium. Through long observation, however, cases have not rarely been seen where the spores fell apart to a greater or less degree, with the resultant formation of a community of detached groups, as shown in fig. 6. It is this variation from the usual course that led, fortunately, to the settlement of the uncertainty that has existed until now as to the presence or absence of a gelatinous matrix in the sporangium that is instrumental in causing the expulsion of the spores. I had long ago convinced myself of the existence of such a substance from the behavior of the spores in emerging in species of *Achlya* under usual and unusual conditions. The formation of a little emergence-papilla just before the escape, the rapidity and violence of the escape when followed by immediate quiescence (the sudden popping of a spore under constriction through a smaller opening would seem impossible under its own steam) and the frequent retention of some of the last spores in the sporangium are all strong evidence of mechanical propulsion under inside tension. And the presence of cilia on the escaping spores (a point that is still in dispute[5]) could scarcely modify the force of the evidence. The actual proof, however, of the presence of such a jelly was still lacking until presented under the conditions shown in fig. 6. If such a brotherhood of newly-emerged spores be disturbed, the *whole archipelago will move as a unit,* showing beyond a doubt that they are all bound together by a jelly that surrounds them. And it is the

[5] See Horn, L. C., p. 221.

swelling of this jelly that ejects the spores from the sporangium.[6]

Very often the spores do not come out, but either emerge through short individual tubes as in *Dictyuchus,* or sprout at once into hyphae as in *Aplanes.*[7] In fig. 7 the spores are emerging simply through holes; in fig. 8 they are escaping through tubes of considerable length. Some were seen in the act of escaping in both of these cases.[8] The passage of the protaplasm through the opening is at first very slow, but when about half way through the flow becomes much more rapid and the escape quickly follows. When free the spore scarcely shows any motion for several minutes, only a barely perceptible and uncertain rocking. Soon the motion becomes more active and in about five or ten minutes, depending on the temperature, the spore swims briskly away. In the case shown in fig. 7, the spores before emergence contained a good-sized vacuole. At the moment of complete emergence this vacuole became suddenly much smaller, probably by contracting and discharging as in the case of *Amoeba.* This was clearly discerned a number of times under the high power. The little depauperate sporangia shown in figs. 7 and 8 were formed immediately from spores sprouting in a large sporangium. When a small insect was placed near them, the end cell was sent out as a long and very delicate hypha that reached the insect and penetrated it. The spores in the sporangia were in a resting condition, but when deprived of air by being covered with a glass for a while, the spores began to emerge as shown. By this method sporangia of *Dictyuchus* and other species that have been resting for some time may be made to empty themselves whenever desired, as I have repeatedly demonstrated.

The oögonia are racemosely borne on straight or bent branches that vary greatly in length. Sometimes they are not one half as long as the diameter of the oögonia; again they may be four times as long. These extremes in length are rare and they usually vary from about one and one half to two and one half times the

[6] For Humphrey's argument against the mechanical expulsion of the spores in *Achlya,* see his Saprolegniaceae of the United States, page 66.

[7] Such variations occur in most of the species of Saprolegniaceae that I have studied. See Lechmere. The New Phytologist 9: 308. 1910; and 10: 167. 1911.

[8] This phenomenon was also observed for this species by Ward. See Quart. Journ. Micro. Scien. 23 N–S: 272. 1883.

diameter of the oögonia. The walls of the oögonia are generally quite round and smooth, but at times they are furnished with low rounded projections at the pits, which are scarcely larger than to make the oögonia appear angular in section (fig. 9). In the walls of many oögonia pits are obviously present at pretty regular distances (fig. 10), but in many others the wall appears to be free of pits except that it is thin over the whole extent that is covered by the antheridia (fig. 11). Intercalary oögonia appear occasionally as shown in fig. 12. The oöspores are eccentric and are very variable in number. Two, four, and six are common numbers, one and eight are not rare, but more than eight are not often seen.

The antheridial branches arise from the same main hyphae as the oögonial branches. They usually extend for a considerable distance, branching either extensively or sparingly, and attach themselves to any oögonia they may meet, whether from their own main hyphae or from others. However, they seem to show some preference for the oögonia of other hyphae, and the antheridia on an oögonium are more apt to be of diclinous than of androgynous origin. This agrees with what Horn found in his plants, as mentioned above, and is contrary to DeBary's observations on his *Achlya polyandra* (*A. DeBaryana* Humphrey). In fig. 13 is shown an antheridial branch which has arisen by the proliferation of a halted oögonial initial, thus showing the essential homologies of the two sorts of organs. This branch has furnished antheridia for two oögonia of the same origin as itself. Not all oögonia are furnished with antheridia, the number without them varying from a small to a rather large proportion in different cultures.

It is now evident that our Chapel Hill form cannot certainly be referred to any described species of the *prolifera* group. If we compare their characters it would seem that our plant is somewhat nearer *A. prolifera* than it is to the others, as the antheridia are most often of diclinous origin, and the oögonia are generally pitted. But as *A. prolifera,* according to DeBary, does not have antheridia and oögonia on the same main hypha, that species is excluded here. And *A. DeBaryana* as described by DeBary (as *A. polyandra*) is equally excluded by its lack of oögonial pits and

the generally androgynous origin of its antheridia. However, from the figures of DeBary and Horn of *A. polyandra* DeBary (*A. DeBaryana* Humphrey), our plant seems really to be very near that species; and it seems best, at present, to extend somewhat the limits of *A. DeBaryana* so as to include Horn's form and our Chapel Hill plant.

Meanwhile, if *Achlya prolifera* can be found again, it should be carefully studied and the limits of its variation determined. If the other two are not distinct from it, then its name must be extended to all of them.

CHAPEL HILL, NORTH CAROLINA.

EXPLANATION OF PLATE LXXVIII

Fig. 1. A typical group of chlamydospores. × 75.

Fig. 2. Chlamydospores of another form. × 75.

Fig. 3. Several sporangia of the short, thick type. × 75.

Fig. 4. A sporangium opening by two tubes. × 75.

Fig. 5. Sporangia of a longer and narrower type. × 75.

Fig. 6. A sporangium like the above. The spores scattered somewhat on emerging. × 75.

Fig. 7. Depauperate sporangia formed from filaments sprouting directly from the spores in a large sporangium. Spores emerging from one filament. × 335.

Fig. 8. A sporangium similar to the above. × 335.

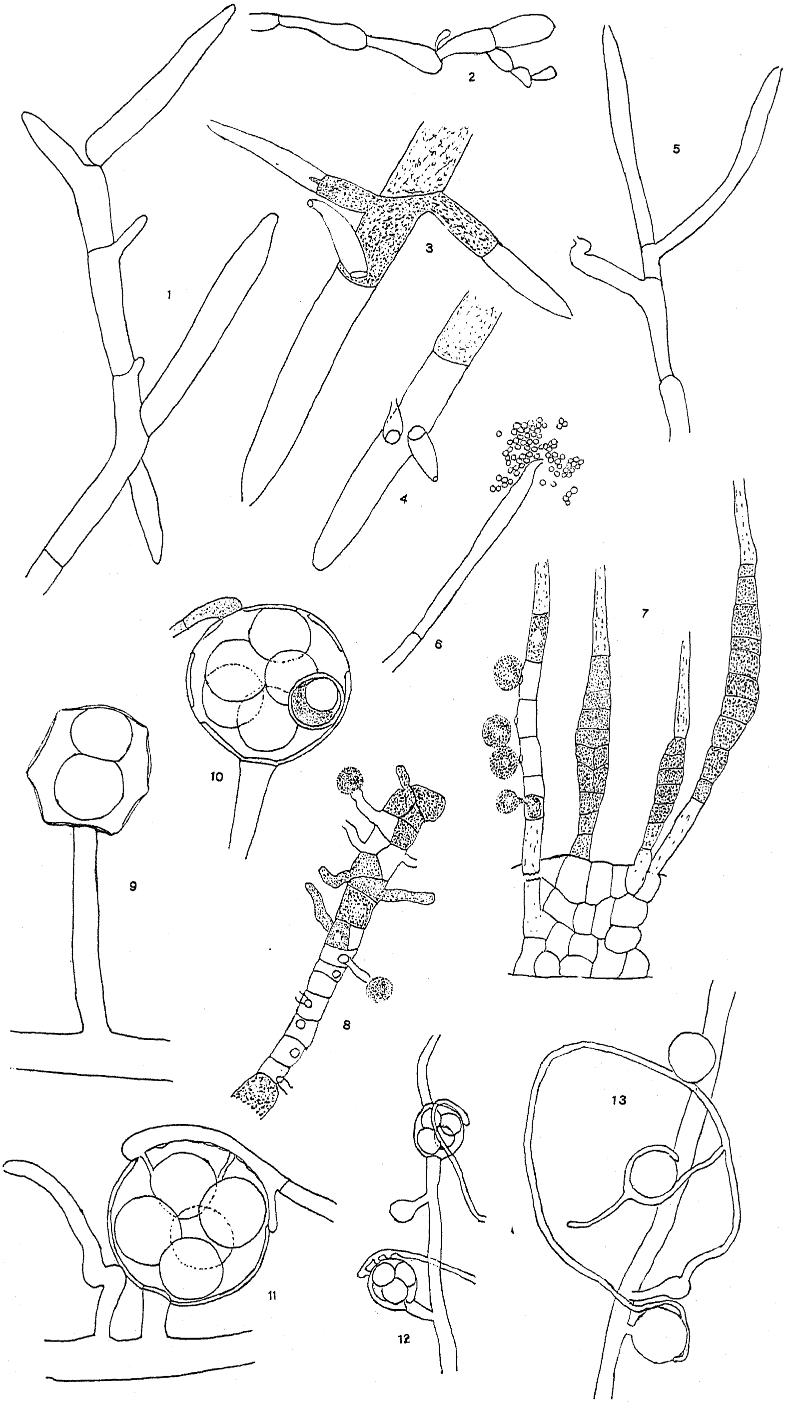
Fig. 9. An angular oögonium showing pits. × 335.

Fig. 10. A typical oögonium with pits; an antheridium attached; the contents of one egg filled in. × 335.

Fig. 11. An oögonium without pits except for the thin area where the antheridium is attached. Two antheridial tubes shown. × 335.

Fig. 12. Two oögonia, one intercalary, with diclinous antheridia. × 125.

Fig. 13. Three oögonia, with antheridial filament of androgynous origin × 125.



ACHLYA DEBARYANA HUMPHREY

ACHLYA GLOMERATA sp. nov.

W. C. Coker

(With Plate 79, Containing 7 Figures)

Hyphae rather stout, branched, not long. About 40–45 mu in diameter at base and tapering to slender tips about 12 mu in diameter at base and tapering to slender tips about 12 mu in diameter. At maturity, the main hyphae strongly incline to segment into elongated sections with dense protoplasm, but the slender apical section is apt to remain almost empty (fig. 1). Zoösporangia almost cylindrical, inclined to be somewhat irregular and often opening by a bent papilla (fig. 2). Oögonia abundant, approximately spherical, without pits; completely covered with short, blunt irregular warts (fig. 3). Oögonia borne on the tips of very slender and delicate, but contorted lateral branches that are either simple, in which case there is but one oögonium (fig. 3), or more or less intricately branched, in which case there are a number of oögonia borne on the tips of the group of branches (figs. 4, 5, and 6). Oöspores single or very rarely two in an oögonium; their diameter 15–23 mu, averaging about 20 mu. Antheridia absent from a good many oögonia, when present, club-shaped; borne on the tips of branches from the same glomerulus and one or several on an oögonium (fig. 5).

This species has been observed several times from two stations at Chapel Hill, North Carolina. The drawings are made from material taken from a cool spring in dense woods ("Lone Pine Spring") on April 30, 1912, and from the springy marsh at the foot of "Lone Pine Hill" on February 29, 1912. Pure cultures have now been kept for about six months.

This species does not closely approach any other; but it seems to be nearest the members of the *racemosa* group. The shape of the antheridia is like those of *A. racemosa* and its relatives, and there is considerable resemblance to the spiny oögonia of *A. racemosa stelligera* and to *A. decorata,* if these two are really distinct.[1] There is also some hint of the habit of *A. glomerata* in the occasional branched oögonial threads of *A. decorata.* In all the

[1] Obel considers *A. decorata* Peterson the same as *A. racemosa* var. *spinosa* Cornu (Annales Mycologici 8: 422. 1910): and Humphrey gives the latter as a synonym of *A. racemosa* var. *stelligera* Cornu.

members of the *racemosa* group the antheridial branches, when present, originate just below the oögonium. In *A. glomerata* they do not thus originate. This distinction with the usually bent and twisted branching habit of the oögonial hyphae separates the species sharply from any of the *racemosa* group. As already mentioned, the oögonia are sometimes borne singly on the ends of simple branches, especially near the tips of the main hyphae, but in such cases these branches are much more delicate and longer in proportion to the oögonia than is generally the case in any member of the *racemosa* group.

The fruiting branches are so abundant and many of them are so elongated and extensively branched that the cultures take on a whitish, cottony appearance except near the periphery, which is usually without branches. In extreme cases this effect is so pronounced that the culture may be compared in appearance to a rug with a fringe. This reminds us of the "woolly snow-white turf" produced by deBary's *Achlya spinosa,*[2] which species, while not in the close family circle of the *racemosa* group, shows its relation to them by its spiny oögonia with generally one egg, and by the origin and shape of the antheridia.

So far as the sexual organs are concerned, there is a remarkably close resemblance between *Achlya glomerata* and *Saprolegnia asterophora* deBary.[3] As in most species of *Achlya*, the spores sometimes remain in the sporangium and sprout there (fig. 7).[4]

CHAPEL HILL, NORTH CAROLINA.

EXPLANATION OF PLATE LXXIX

Fig. 1. Part of filament from an old culture, showing segmentation into chlamydospores. Part of one long cell is omitted. The contorted tip cell is almost empty. × 185.

Fig. 2. A group of sporangia in different stages. × 125.

Fig. 3. A simple oögonial filament with one oögonium. × 335.

Fig. 4. A branched oögonial filament with two oögonia. × 335.

Fig. 5. A more complex group of oögonia, not all shown. One is intercalary. × 335.

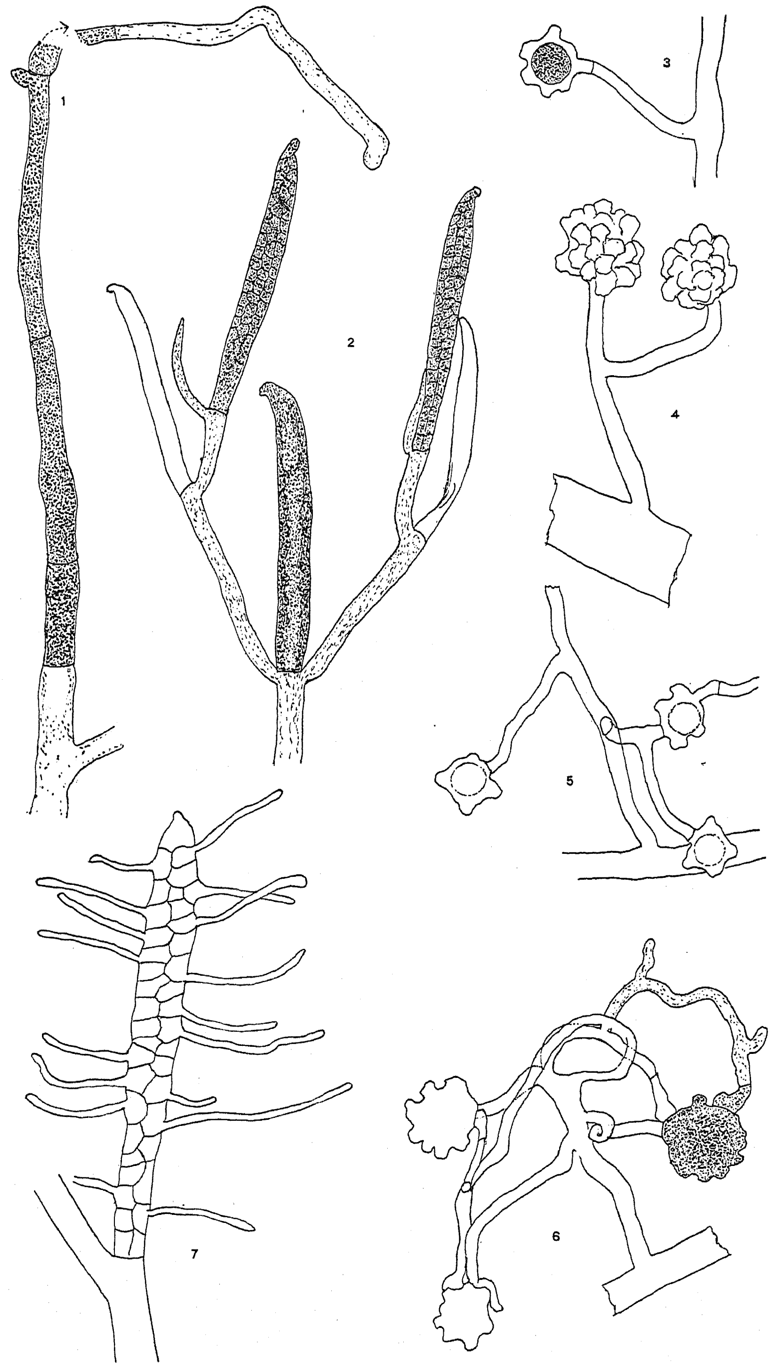
Fig. 6. A characteristic group of oögonia with antheridia. The protoplasmic contents are shown only in part. × 335.

Fig. 7. A sporangium in which the spores became encysted and sprouted in position. × 335.

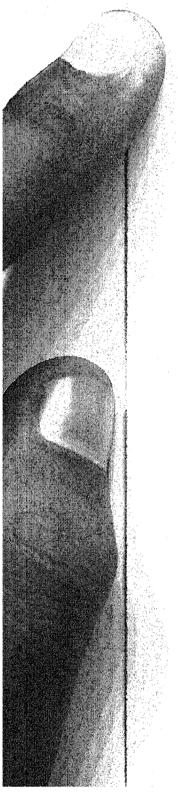
[2] Botanische Zeitung **46**: 647. 1888.

[3] See Beitr. zur Morph. und Phys. der Pilze, IV. Reihe, 1881.

[4] See article by the author in Bot. Gaz. **50**: 381. 1910.



ACHLYA GLOMERATA COKER



NEWS AND NOTES

The first Mexican Scientific Congress will be held in the City of Mexico on December 9 to 14.

Mr. G. F. Gravatt has been appointed pathologist in charge of the chestnut canker investigations in Virginia, which will include first of all a survey of the state to locate the infected areas.

The proceedings of the Pennsylvania Chestnut Blight Conference, held at Harrisburg, February 20 and 21, 1912, have been recently printed in full in a very attractive and well illustrated volume of 253 pages.

Professor W. J. Wright, formerly of the department of horticulture of the Pennsylvania State College, has resigned to accept the directorship of the New York State School of Agriculture at Alfred University, Alfred, New York.

According to the observations of C. Wehmer (Ber. Deutsch. Bot. Gesell. 29: 704–708), oak wood is much more highly resistant than pine to the attacks of dry rot (*Merulius lacrymans*), although easily invaded by many other fungi.

An important illustrated paper on the fungous flora of arable soils, by Dr. C. N. Jensen, has recently appeared as Bulletin 315 of the Cornell University Agricultural Experiment Station. It contains a few new species and many interesting observations.

Mr. L. O. Overholts, of the department of botany of Miami University, Oxford, Ohio, was granted a research scholarship at the Garden during August and September. He devoted his attention to the completion of a list of the Polyporaceae of Ohio, with full keys to the genera and species.

Porfessor W. G. Stover, of the Oklahoma Agricultural Experiment Station, has been appointed assistant professor of botany in Ohio State University for the coming year. Mr. Stover is a graduate of Miami University and was at one time a student at the Garden.

Mr. P. J. Anderson, field pathologist of the Pennsylvania Chestnut Tree Blight Commission, and Professor H. W. Anderson, investigator for this Commission, visited the Garden August 14 to examine herbarium specimens and literature of fungi relating to the chestnut blight.

Bulletin 255 of the Bureau of Plant Industry at Washington, by Dr. E. F. Smith and Assistants, contains numerous illustrations showing the effects of crown gall on plant tissues, with a brief discussion of the disease and the results of investigations on the subject.

The entire herbarium of the late Professor Alfred James McClatchie, of Throop Polytechnic Institute, Pasadena, California, has recently been purchased by the New York Botanical Garden. It contains 1,835 specimens of fungi, many of which are valuable types.

Dr. F. D. Heald, formerly professor of botany in the University of Texas, is now an investigator under the Commission for the Investigation and Control of the Chestnut Tree Blight Disease in Pennsylvania, with his headquarters at the Zoology Building, University of Pennsylvania, Philadelphia.

Dr. A. F. Blakeslee has a year's leave of absence from the Connecticut Agricultural College. He has a temporary appointment on the staff of the Carnegie Station for Experimental Evolution at Cold Spring Harbor, Long Island, New York, where he will spend the year in research work on the lower fungi.

Dr. P. Baccarini has studied the effects of *Daedalea unicolor* on living trees of *Acer rubrum* in the botanical garden at Flor-

ence, and believes that the trees are gradually killed by this fungus, which causes a special decay of the wood, transforming it into a white, fibrous, very fragile mass.

Professor Bruce Fink, of Miami University, Oxford, Ohio, desires to see fresh material in abundance of species of the Collemaceae collected in various parts of North America. This group of lichens is greatly in need of careful modern taxonomic treatment and Professor Fink will devote much of his time to it during the next two years.

Bulletin 247 of the Bureau of Plant Industry at Washington is devoted to the discussion of a knot of citrus trees caused by *Sphaeropsis tumefaciens,* by Florence Hedges and L. S. Tenny. This disease, which has been known on lime- and orange-trees in Jamaica for several years past, has recently been reported from Florida. Careful pruning is recommended and great care is advised in order to prevent the spread in this country of a new citrus fruit disease.

In the Gardener's Chronicle for 1911, G. Webb describes a successful treatment of hollyhocks against attacks of the rust (*Puccinia malvacearum*) by the application of a powder which consists of 1 bu. of slaked lime, 1 bu. of soot, 4 lbs. of flowers of sulphur, and 2 oz. of finely powdered sulphate of copper. This mixture should be passed through a fine sieve and the plants dusted with the powder three or four times during the growing season, in the morning while the dew is still upon them.

The first number of a new journal bearing the name *Mycologisches Centralblatt* and devoted to general mycology appeared in February, 1912, edited by Dr. C. Wehmer in Hannover, and published by Gustav Fischer in Jena. The associate editors are: Blackman, Blakeslee (U. S.), Elfving, Erikson, Fischer, Giesenhagen, Klebahn, Lagerheim, Maire, Meyer, Molisch, Transchel, Tubeuf, Went, Zellner, and others. These names are sufficient to indicate the broad scope of the new journal.

The report of the state botanist, Dr. C. H. Peck, for the year 1911, containing 120 pages of text and 9 colored plates, appeared about August 15, 1912, as Bulletin 157 of the New York State Museum. The most important part of this report is probably a monographic treatment of the 64 New York species of the difficult genus *Clitocybe*. The 23 species of *Psilocybe* found in the state are also monographed; and 44 new species of fungi are described. Among the interesting observations recorded, is one regarding the death of two children from eating *Pholiota autumnalis*, and another giving measurements showing the average daily growth of the giant puffball, *Calvatia gigantea*, after its appearance above ground.

Species of Hydnaceae appear to be scarce on the Pacific Coast, as elsewhere. The following, determined by Professor H. J. Banker, deserve mention:

Auriscalpium Auriscalpium (L.) S. F. Gray. Abundant on cones under coniferous trees; rarely in humus. Corvallis, Oregon, *Murrill 924, 984;* Mill City, Oregon, *Murrill 876.*

Manina cordiformis Scop. (*Hydnum Erinaceus* Bull.) On a log of *Pseudotsuga*. When drying, it smells strongly of licorice. Seattle, Washington, *Murrill 124.*

Manina coralloides (Scop.) Banker. Several large, creamy-white clusters 25 cm. high and bearing teeth 1 cm. in length were found on an immense log of *Pseudotsuga*. Seattle, Washington, *Murrill 121, 122.*

Hydnum dichroum Pers. Growing at the base of a deciduous stump in fir woods. Corvallis, Oregon, *Murrill 891.*

Odontia fimbriata (Pers.) Fries. Common in some localities. According to Professor Banker, the subiculum is remarkably thick for the species. Corvallis, Oregon, *Murrill 938;* Preston's Ravine, near Palo Alto, California, *Murrill & Abrams 1177, 1194.*

Professor John G. Hall, of Clemson College, South Carolina, contributes the following note on the identity of the fungus causing the large leaf-spot of chestnut:

MONOCHAETIA DESMAZIERII.—"In MYCOLOGIA, vol. 4, no. 4,

Mr. A. H. Graves describes a large leaf-spot chestnut and attributes the disease to *Monochaetia Desmazierii* Sacc., giving *Quercus rubra* as another host. I have also found the disease upon *Quercus nigra* in abundance in this neighborhood. Mr. Graves says that Dr. Farlow examined the original material of *M. Desmazierii* and found that the spores were not mature but that later he examined other material sent out by Desmazières and found that this material agrees with the fungus upon the chestnut, and that it also agrees with Desmazières' description of the fungus. He also cites the fact that Dr. Stevens and myself mentioned a similar disease of chestnut in our 'Diseases of Economic Plants,' and suggests that they may be caused by the same organism.

"I have every reason to believe that the disease described by Mr. Graves is identical with that described by us and is caused by the same fungus. However, the identity of the fungus seems to be in doubt. According to the descriptions in Saccardo, the only authority available to us when 'Diseases of Economic Plants' was published, the fungus is *Monochaetia pachyspora* Bubak, as it has three dark-colored cells in the center of the spore, while *Pestalozzia monochaeta* Desm., which becomes *M. Desmazierii* Sacc., has only two such cells. At the end of the description of *M. pachyspora,* Saccardo says that the spores of this fungus are thicker than those of *M. Desmazierii,* while our measurements agree with those given for *M. pachyspora*. It seems to me that the name *M. pachyspora* should become a synonym of *M. Desmazierii* but that the description of the latter should be revised to correspond with the original specimen and description as written by Desmazières."

New Combinations for Tropical Agarics

A number of species of gill-fungi described by me from tropical America in MYCOLOGIA, 1911–1912, under genera not found in Saccardo's *Sylloge,* are here recombined for the benefit of those having or using herbaria arranged according to this work. Collectors, pathologists, and others who may not be in-

timately acquainted with taxonomic methods will probably find it more convenient to follow the one system until a comprehensive revison is completed, at least for some important groups.

Conocybe echinospora	= **Galera echinospora**
Hydrocybe albo-umbonata	= **Hygrophorus albo-umbonatus**
Hydrocybe aurantia	= **Hygrophorus aurantius**
Hydrocybe Earlei	= **Hygrophorus Earlei**
Hydrocybe flavolutea	= **Hygrophorus flavoluteus**
Hydrocybe hondurensis	= **Hygrophorus hondurensis**
Hydrocybe rosea	= **Hygrophorus roseus**
Hydrocybe subcaespitosa	= **Hygrophorus subcaespitosus**
Hydrocybe subflavida	= **Hygrophorus subflavidus**
Hydrocybe subminiata	= **Hygrophorus subminiatus**
Hydrocybe troyana	= **Hygrophorus troyanus**
Leptoniella atrosquamosa	= **Leptonia atrosquamosa**
Leptoniella cinchonensis	= **Leptonia cinchonensis**
Leptoniella Earlei	= **Leptonia Earlei**
Leptoniella mexicana	= **Leptonia mexicana**
Leucomyces mexicanus	= **Amanita mexicana**
Leucomyces mexicanus	= **Venenarius mexicanus**
Limacella agricola	= **Lepiota agricola**
Melanoleuca jalapensis	= **Tricholoma jalapensis**
Melanoleuca jamaicensis	= **Tricholoma jamaicensis**
Melanoleuca subisabellina	= **Tricholoma subisabellina**
Mycena jalapensis	= **Bolbitius jalapensis**
Mycena mexicana	= **Bolbitius mexicanus**
Pleuropus Earlei	= **Clitopilus Earlei**
Venenarius mexicanus	= **Amanita mexicana**
Volvariopsis Bakeri	= **Volvaria Bakeri**
Volvariopsis cubensis	= **Volvaria cubensis**
Volvariopsis Earlei	= **Volvaria Earlei**
Volvariopsis jamaicensis	= **Volvaria jamaicensis**

W. A. MURRILL.

INDEX TO AMERICAN MYCOLOGICAL LITERATURE

This index is prepared by Dr. B. O. Dodge, of Columbia University, and covers the same scope for the fungi as that covered by the general index published monthly in the Bulletin of the Torrey Botanical Club. It is not reprinted on cards for distribution.

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Includes short account of the history of the scab, the fungus in cultures, germination of spores, infection experiments and preventive measures.

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Hedgcock, G. G. A *Cronartium* associated with *Peridermium filamentosum* Peck. Phytopathology **2**: 176, 177. Au 1912.

Hedges, F., & Tenny, L. S. A knot of citrus trees caused by *Sphaeropsis tumefaciens.* U. S. Dept. Agr. Plant Ind. Bull. **247**: 5–74. *pl. 1–9* + *f. 1–8.* 17 Au 1912.

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New names, and the final members of new combinations, are in **bold face type**